A Third-Generation Direct-Entry System for Gathering Biological Data from Fish

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2005

Canadian Technical Report of Fisheries and Aquatic Sciences 2609

Fisheries and Oceans Pêches et Océans

Canada

Canadian Technical Report of Fisheries and Aquatic Sciences

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106-01955/

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Canadian Technical Report of Fisheries and Aquatic Sciences 2609

©Her Majesty the Queen in Right of Canada. 2005.
Cat. No. Fs 97-6/2609 **ISSN 9706-6457**

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Published By:

Fisheries and Oceans Canada
200 Kent Street
Ottawa, Ontario
K1A 0E6

Correct citation for this publication:

Bourque, Clarence and Colin MacDougall, 2005. A Third-Generation Direct-Entry System for Gathering Biological Data from Fish. Can. Tech. Rep. Fish Aquat. Sci. 2609:75p.

Table of Contents

Table of Contents iii
Abstract./Résumé vi
Introduction 1
Objective 1
Herring Assessment Data Collection 1
The Evolution of a Digital Direct-entry System 3
The 32-Bit HrSchool Software Suite 3
Hardware and Platform Requirements 3
The Software Component 4
Automated Data Gathering Using 32-Bit HrSchool 7
Using the Software 8
HrSchool 8
HerBase 9
CSurvey 16
CSurvey132 17
CSurvey232 21
Capther4 25
FMBoardApps 29
Process 33
GetNewLimits 34
User Documentation 35
Results 36
Acknowledgements 37
References 37

LIST OF APPENDICES

A: Images of HrSchool Windows 39
a) Image of the HrSchool Main Window First Menu Item Selected 39
b) Image of the HrSchool Main Window Second Menu Item Selected 39
c) Image of the HrSchool Main Window Third Menu Item Selected 40
d) Image of the HrSchool Main Window Fourth Menu Item Selected 40

B: Images of HerBase Windows 41
a) HerBase File Information Window 41
b) HerBase Log Information Window – Field Sample 41
c) HerBase FMB IV on Check Warning 42
d) HerBase Backup Filename Notification Window 42
e) HerBase Fish Measuring Window 43
f) HerBase Log Information Window – Enter or Edit Data 43
g) HerBase Log Information Window – Search by Sample 44
h) HerBase Log Information Window – Search by Field 44
i) HerBase Length Frequency Entry Window 45
j) HerBase Graphing A Length Frequency 45
k) HerBase Age Data Entry 46

l) HerBase Possible Age Error Warning Screen 46
m) HerBase Detail Data Editing 47
C: Images of CSurvey Windows 48
a) CSurvey Main Window 48
b) CSurvey Main Window Drop-down Menu 48
c) CSurvey About Message Box 49

D: Images of CSurvey132 Windows 50
a) CSurvey132 Main Window 50
b) Csurvey132 Set and Species Information Window 50
c) CSurvey132 Sampling Options Window 51
d) CSurvey132 FMB IV On Check Message Box 51

E: Images of CSurvey232 Windows 52
a) CSurvey232 Main Window 52
b) CSurvey232 Set and File Information Window 52
c) CSurvey232 Station Card Data Window 53
d) CSurvey232 Species Specific Sampling Data Window..... 53

F: Images of Capther4 Windows 54
a) Image of Capther4 Opening Window (Choose Action Menu)..... 54
b) Image of Capther4 Opening Window (Help Menu) 54
c) Image of Capther4 About Window 55
d) Image of Capther4 Sample Information Input Window 55
e) Image of Capther4 Sample Not Found Message Box Window..... 56
f) Image of Capther4 Sample Previously Processed or
Comment Found Warning Window 56
g) Image of Capther4 Processing Aborted By User Window 57
h) Image of Capther4 Verify FMB IV Is On Warning Window 57
i) Image of Capther4 Fish Processing Window 58
j) Image of Capther4 Comment Entry and Number Done Verification Screen 58
k) Image of Capther4 GetNewLimits Screen 59
l) Image of Capther4 System In Operation..... 59
m) Image of Capther4's Process Facility Input Window 60

G: Images of FMBoardApps Windows 61
a) Image of FMBoardApps Main Window with Menu..... 61
b) Image of FMBoardApps About Information Window 61
c) Image of FMBoardApps Warning Message Box (check that FMB IV is on)... 62
d) Image of FMBoardApps Set Baud Rate Window 62
e) Image of FMBoardApps Send a Command to the FMB IV Window 63
f) Image of FMBoardApps
Initialize the FMB Sensor Definitions Selections Window..... 63
g) Image of FMBoardApps Destructive Poll of the FMB IV Window..... 64
h) Image of FMBoardApps
Download Previously Recorded Data from the FMB IV Window.... 64

H: Representative Scatter Plots of Length vs. Weight..... 65

ABSTRACT

The Department of Fisheries and Oceans scientific staff at the Gulf Fisheries Centre, in Moncton, New Brunswick measure 80,000 to 120,000 herring and gather detailed biological data from 6,000 to 10,000 of these each year as part of the annual stock assessment and evaluation process. These fish come from samples of the commercial fishery, at-sea surveys and other research projects carried out each year. To enhance efficiency and accuracy an automated on-line computerized data entry, coding and verification system was developed. This system was updated to a more user-friendly graphic user interface based system compatible with 16-bit computer and networking technology. The enhanced multimedia capabilities and faster hardware found in modern computers as well as network compatibility issues and security constraints commonly in place on Local Area Networks made it necessary to update the software to be compatible with the 32-bit Windows XP® platform. The updated software uses multimedia prompting and warning messages to improve efficiency, reduce errors and user fatigue. New graphic user interface based software was developed to replace outdated MS-DOS® based programs used to manipulate and initialize the electronic fish measuring board hardware component which are no longer fully supported under modern platforms.

This document provides an overview of the system's different facilities including main data-gathering functions and utilities developed along with the main software.

RÉSUMÉ

Le personnel scientifique du Département de Pêches et Océans au Centre des Pêches du Golfe, à Moncton, au Nouveau-Brunswick mesurent 80 000 à 120 000 harengs et recueillent des données biologiques détaillés de 6 000 à 10 000 de ceux-ci chaque année comme partie de l'évaluation annuel des stocks. Ces poissons viennent de la pêche commerciale, des relevés en mer et d'autres projets de recherches faits pendant l'année. Pour améliorer l'efficacité et l'exactitude un système automatisé et en ligne d'entrée direct, de codification et de vérification des données fut développé. Ceci fut amélioré, simplifiant l'utilisation en transformant le logiciel à un système d'interface d'utilisateur graphique, utilisant la technologie digitale de 16 bits. Due à l'amélioration des fonctions multi médiatiques, des composants électroniques plus efficaces disponibles dans les ordinateurs modernes ainsi que les issues de compatibilités avec les réseaux locales et de sécurité, le composant logiciel du système fut modifié à une forme compatible avec le plateforme Windows XP® 32 bit. Ce nouveau logiciel fait plein usage des habilités multi médiatiques pour les messages à l'utilisateur pour améliorer l'efficacité et réduire d'avantage les erreurs et la fatigue pour l'utilisateur. Un nouveau logiciel a base d'interface d'utilisateur graphique fut développé pour remplacer certain programmes pour MS-DOS® auparavant utilisés pour manipuler et initialiser la planche à mesurer électronique suffit qu'ils ne sont plus supporté par les plateformes modernes.

Ce document présente une vue d'ensemble des différentes facilités inclus dans le système, incluant les fonctions qui font la collecte des données et les utilités écrites pour fonctionner avec le logiciel principale.

INTRODUCTION

Scientifically sound population assessment and evaluation of commercially exploited marine species is a cornerstone of sound fisheries management principals. A large and current database of biological information documenting changes in the structure of a fish population is required in order to obtain accurate results when using modern statistical assessment tools. The time period available for production of this type of base data can be short and human resources are often restricted. Traditional methods of data gathering include many steps of manual data recording and verification and, besides being relatively inefficient, allow errors to enter the data files from which they must be corrected or removed at a later date. Any erroneous data which cannot be identified and corrected may reduce the accuracy of advice to managers. Therefore, it is of interest to biologists to find more efficient and accurate methods of producing this information. For these reasons, attempts at automating data gathering for herring population assessments for Southern Gulf of St. Lawrence herring using digital instruments and integrating software were undertaken. Initial work focused on specific tasks and operated in a simple environment (Bourque and Cairns, 1994), but led to a more elaborate system incorporating more tasks and a more user-friendly environment (Bourque and MacDougall, 1998). Building on advancements in digital computer technology, the better understanding of what would be advantageous gained by using these previous systems and guided by network administration and security issues, a new software suite was developed to better efficiency and accuracy. This report documents this system, the 32-Bit HrSchool Suite.

OBJECTIVE

Seeing potential advantages, it was decided that, in the 32-Bit version of the software, facilities should be available to automate the entire data gathering process. This would permit inclusion of error prevention and detection routines wherever possible, avoiding coding, recording and keyboarding errors. It was important that the system be intuitive and rather straightforward to use to reduce training time. Because of compatibility issues, a new 32-bit Windows facility for manipulation and initialization of the Limnoterra FMB IV was also needed. Documentation of the software and its use should be at the same time very complete, accessible and easy to use at any time.

HERRING ASSESSMENT DATA COLLECTION

Data collection for herring population assessment and evaluation by the staff of the Fisheries and Oceans staff based at the Gulf Fisheries Centre is a three step process (Bourque and MacDougall, 1998). This produces the primary data required for annual stock assessment of herring using Virtual Population Analysis models and for various research projects. The three data gathering steps are:

1. collection of commercial or research samples' length frequency data, the related catch and landing information, and preservation of a length-stratified detailed biological sample (350 - 500 samples or 80,000 – 120,000 fish measured per year)

2. fish dissection and detail biological data acquisition from the preserved sample in the laboratory

(6,000 to 10,000 fish dissected per year)

3. determination and recording of each individual dissected fish's age as read from otoliths removed during the laboratory examination

Analysis of the detail biological data with a Gonadosomatic Index program, then results in assigning of individuals to a spawning group (spring or fall) in preparation for virtual population analysis. During at-sea surveys on herring, data (including detailed biological data) may also be collected from incidental catches of other species. The 32-bit version of HrSchool is a software suite of seven individual programs which have facilities designed to efficiently and accurately perform all data collection processes, do file editing and some software procedures required for equipment maintenance and set-up. Each member of HrSchool may be run independently or from the convenient HrSchool integrating software interface.

Using 32-bit HrSchool, catch information and length frequency data from the commercial fishery may be recoded in the field using an electronic fish measuring board hosted by a Windows 98 SE or Windows XP PC. The necessary electronic logbook information for the catch is entered, coded and written to file, length frequency data are gathered, compiled and written to file. During the measuring process, the user is prompted using both visual and audio prompts to keep individual fish if required for a length-stratified detailed biological sample. Should conditions warrant, length-frequency and catch data may also be gathered using a traditional hardwood measuring board and recorded on paper, and the data may be entered at a later date using the HrSchool software.

During at-sea research missions, herring and all other species including groundfish may be measured and other data recorded using an FMB IV with or without an integrated balance to enter individual fish weights and HrSchool software running on a Windows 98 SE or Windows XP PC. All standard sampling protocols are supported including sexed and unsexed length frequencies, recording detailed biological information and tracking fish and otolith numbers if removing otoliths while doing length frequencies (as is normally done with groundfish). When convenient, the data may then be merged with navigational, hydrographical and environmental data using HrSchool software. Data are written to standard, ASCII format archival files as adopted by the herring and groundfish assessment groups of the Marine Fish Division, Gulf Region.

Biological herring samples taken during commercial and research sampling are frozen and transported back to the laboratory. Data are gathered using the HrSchool laboratory data direct-entry software and associated hardware. As soon as data are entered, validation scripts are run and suspect data are flagged for verification by the user. Data are automatically coded and written using non-conflicting sequential write access routines (a file access methodology permitting several users to seemingly simultaneously work with and modify the contents of a common file without conflict or data loss (Bourque and MacDougall, 1998)). Data are written directly to a central file on one of network's scientific servers which is automatically backed-up every day, with weekly and monthly backups stored off-site. As each fish is processed, otoliths are removed and cleaned then dried and set in synthetic resin in black acrylic otoliths trays. Once the resin has dried, the fishes' ages are determined using a microscope and the data recorded using the HrSchool software which verifies that the fish length at age is reasonable and asks the user to verify doubtful data before accepting it.

THE EVOLUTION OF A DIGITAL DIRECT-ENTRY SYSTEM

With the development of digital balances and especially of electronic fish measuring boards of sufficient precision and durability (Armstrong, D.W et al, 1986, Armstrong et al, 1989, Newton, A. W., 1984, Morizur, Y., P. Lespagnol and A. Ogor, 1992, Chaput et. al., 1992) it became possible for fisheries biologists to develop systems permitting direct recording of fish biological data (Grainger, R. J. R., and S. McLoughlin, 1986, Rubec and Planck, 1984). Simple systems, written in higher-level languages such as BASIC that automated only part of the data gathering proved more efficient and produced better data than traditional methods (Bourque and Cairns, 1994).

With improvements in technology, much more elaborate software could be written using a more powerful low-level computer language and designed to run on user-friendly Graphic User Interface (GUI) based platforms. These could permit automating more of the data collection process and possess more stringent validation capabilities, eliminating errors before they entered the data files. Common design elements and compatibility led to the integration of programs into a software suite producing the original 16-Bit version of HrSchool (Bourque and MacDougall, 1998). The ability to transfer data to other computers via Local Area Networks (LANs) permitted alternative file-management methods to be put into service. GUI-based operating systems also proved to be more intuitive and more standardized both in look and functionality, reducing training time and increasing efficiency.

Another advantage of the GUI type platform was the ease of incorporating detailed documentation using the WinHelp® system. WinHelp runs independently from other programs on the platform and therefore can be kept open and referred to while other software is running. By incorporating detailed images and hot links permitting the user to jump directly to related subjects, it offers a powerful reference tool for the user. WinHelp files are installed on the host computer along with the software and are accessible directly from program menus so documentation is always at hand.

Modern computers running 32-bit platforms such as Windows XP have enhanced multimedia, networking and sound generation capabilities. They provide the possibility of using prompts incorporating complex sounds such as human speech to make data gathering even more efficient and accurate.

To take full advantage of these possibilities, a new 32-bit software suite was written based on and further developing the basic principals developed for the 16-bit HrSchool (Bourque and MacDougall, 1998).

The 32-bit version of the HrSchool software suite is comprised of 9 interlinked programs which permit automated data gathering, entry, coding and verification at all steps of the assessment biological data production process. It also contains a context-sensitive, detailed user's guide and reference manual delivered via the WinHelp system.

THE 32-BIT HRSCHOOL SOFTWARE SUITE

HARDWARE AND PLATFORM REQUIREMENTS

All software was compiled to take advantage of computers with Pentium IV class processor

running Windows XP® but will run on older Pentium class machines running the Windows 98 SE® platform. The computer must have 128 megabytes of RAM if running Windows XP, 64 megabytes if running Windows 98 SE and at least 300 megabytes of free hard disk space and two RS-232 serial ports - com1 and another - available. A second, removable media drive (diskette, Zip Disk, removable hard drive, memory stick or other) is essential for data security when working in the field. For laboratory, aging and related work, main files are normally written to a server on the network, so the host's hard drive may be used for backup. Although access to a Local Area Network (LAN) is not, in fact, strictly required for the Capther4 and HerBase software to work it is essential component for the system to attain its true efficiency and maximum data security. This will require the host computer to have an Ethernet card and network software installed and that there be a LAN access jack within reach of the workstation area.

For field and laboratory work, each workstation requires a Limnoterra FMB IV electronic fish measuring board. It may be purchased in two resolutions: the "standard" ¼ cm resolution, one meter measuring surface and a one millimeter resolution board with 80 cm of actual measuring surface in a one meter case. Either may be used with the system and should produce the same accuracy when measuring adult herring (Bourque and Cairns, 1994).

A Sartorius model BP4100 or equivalent electronic balance is also required for direct entry of weights in the laboratory and during at-sea sampling.

THE SOFTWARE COMPONENT

All software in the 32-Bit version of HrSchool was written and compiled using the Borland C++ Builder 6 Integrated Development Environment. WinHelp .rtf source files were compiled using the Microsoft Help Workshop version 4.03.002. The HrSchool suite was written in several distinct programs to save on loading time and RAM memory. Some functions that were in separate programs in the 16-bit version (Bourque and MacDougall, 1998) have been merged, but new programs have been added to do research sampling at sea (where protocols and data collected are often quite different from commercial sampling and require processing of other pelagic or groundfish species). A user-friendly software for programming and manipulating the Limnoterra FMB IV was developed and may be called from links included in all software that are designed to be used with one. As in the older version, these programs are designed to complement each other and permit efficient, secure gathering, editing and maintenance of accurate, properly coded and formatted data files on herring and other fish species. Non-conflicting sequential access (Bourque and MacDougall, 1998) is still used to enable entry and editing of data on central files by several workstations at the same time without loss or conflict.

The HrSchool Suite for 32-Bit Windows now is composed of the following software:

HrSchool is a general integrator interface giving access to the entire suite of software. Although each facility is designed to run independently, HrSchool provides easy access to the right module through a simple drop-down menu system. It also contains comprehensive WinHelp documentation with information on all modules.

HerBase permits computer entry and editing of herring commercial catch information, length-frequency, and individual fish age data. It has facilities that permit entry of catch information and individual fish lengths in the field using a notebook computer and an FMB IV, for entering by hand manually gathered and recorded length-frequencies and related data, and to permit fish age readers to enter and verify fish ages against length as otoliths are read. HerBase is also designed to be a database editor for the comma delineated herring ASCII archival database files produced by HrSchool programs.

It is designed to simplify coding and to standardize data by automatically determining such things as sample number and NAFO sampling area (determined from the latitude and longitude entered) and using drop-down list boxes for data entry whenever possible. Auditory and textual prompts and warnings are used wherever useful to ensure accuracy and efficiency. A link to the FMBoardApps FMB IV initialization and manipulation software described below is included and enables such work to be done without closing HerBase.

CSurvey is a software and hardware system designed to permit efficient and accurate gathering and entry of data normally gathered during assessment related at-sea research surveys. Using direct-entry from digital devices such as electronic balances and the Limnoterra FMB IV electronic fish measuring board, and graphic user interface ("GUI") software, it maximize efficiency and minimize or eliminate common errors usually found in unedited data. As required, CSurvey activates subunits which have distinct but inter-related functions. One permits immediate direct entry of biological data from the fish caught (Csurvey132), another integrates navigational, hydrographical and catch information with the biological data and produces final format archival ASCII files (CSurvey232), and one that permits programming and manipulations of the Limnoterra FMB IV (FMBoardApps).

Csurvey132, a subunit of CSurvey, integrates software and hardware to allow the user to directly acquire, format and write length-frequency and detailed biological data of herring and all species of groundfish captured during at-sea research trawl surveys carried out for stock assessment purposes to a digital file. It produces an easy to read, ASCII format, intermediate compiled length frequency. It also outputs a list of lengths and biological data file. When convenient, these are are combined with navigational, hydrographical and environmental data using the Csurvey232 facility to produce final format length frequency, detailed biological data and other standard files. CSurvey132 has the ability to record all data normally collected by the scientific staff of the Gulf Fisheries Center on all pelagic and groundfish that may be caught by scientific trawl surveys in the Gulf of St. Lawrence.

At this time, CSurvey 132 supports several distinct sampling protocols including:

- Herring length-frequency sampling (½ cm interval) with length-stratified sub-sample kept
- Standard groundfish length-frequency sampling (1 cm interval)
- Sexed length-frequency sampling
- Detailed biological sampling while doing length-frequencies (includes automated otolith number tracking and optional direct entry of fish weights)
- Special Cod, White Hake and flatfish sub-sampling stratification protocol adopted by Gulf Region in 2001

Csurvey232, also a subunit of CSurvey, simplifies and error-proofs coding, entry, and merging of navigational, hydrographical and environmental data, combines it with the length and biological data electronically gathered using the CSurvey132 facility to produce standard ASCII archival format files. It produces both the comma-delimited herring archival data files in use by the Gulf Region Fisheries Herring Research and Assessment Group as well as standard ASCII format archival groundfish research survey files as used by Gulf Region Fisheries Groundfish Research and Assessment Group as of 2005. It reduces the amount of manually-entered data (by directly accessing fish lengths and biological data entered using the CSurvey132 automated fish measuring and data entry system), automatically codes information and permits entry of data via drop-down lists whenever feasible to

reduce entry errors.

Capther4 is a software system integrating a computer and other hardware into a system that allows the user to directly acquire, verify, code, format detailed herring biological data normally gathered for stock evaluation purposes and write them to a central file located on a network server. Using data entered previously using the HrSchool programs HerBase or CSurvey as well as direct input from a Limnoterra FMB-IV® electronic fish measuring board and an electronic balance it permits efficient and accurate production of detailed herring biological data.

Capther4 Version 2 was inspired by information gathered while using previous versions, starting with the original Capther Detail Herring Laboratory Processing System (Bourque and Cairns, 1994). With still better user prompting and errant data reporting than the 16-bit Capther3 (Bourque and MacDougall, 1998), it also is specifically designed to take advantage of existing Local Area Networks (LANs) and to allow multiple users to work with common data files at the same time without conflict using network access.

The software does data verification in real time so errant data are flagged before the specimen is destroyed, measurements may be done again and errors eliminated before they enter the data files. Check values are read from an ASCII initialization file which is easily updated at any time using the built-in function available via the main menu, reflecting changes in the population.

Before processing begins, Capther4 locates the sample in the logbook file and extracts information (such as sample number) that it needs. The data fields used to match Detail biological sub-samples to the length-frequency and catch data are: Date, Port (or survey designator), Sampler's Name and Sampler's Number. These should, in combination, be unique for each sample and therefore give a positive match. Special processing instructions or comments which may have been inserted in the logbook comment section while data was entered using HerBase or CSurvey232 are displayed immediately after the sample is located in the electronic logbook file. If a sample is not completely processed during a single session, the number of fish already processed will also be displayed the start of the next session started to process the remaining fish. This way, the otolith tray from the previous session may be retrieved so that new otoliths may be placed in it. At the end of the actual processing, the logbook is automatically updated with date processed, number of fish done and processor's comment, if any.

During actual fish processing, textual and audio prompts and error-messages are used to inform the user what data must be input and the status of data after error checking routines have verified them. Once actual processing begins, the user need not use the keyboard again until the sample is completed. All inputs, including corrections, error-checking override commands, and even comments are made via the "wet end" input devices until the sample is completely processed. Besides being more efficient, this also protects the computer keyboard and mouse from being damaged by offal or clinging to the user's gloves. An embedded link to the Windows default text editor (usually notepad) to visually check the electronic logbook in case a sample is not found eliminates the need to leave the program to do so. Capther4 also has a facility to update the criteria used to validate data at any time and has an access point for the "Process" facility (described below) to obtain information about the progress of sample processing. FMBoardApps (see below) may also be accessed without leaving the software should the FMB IV need to be re-initialized or otherwise manipulated. Capther4 is designed to make the detail biological data gathering process less arduous, more efficient and accurate.

FMBoardApps is a true C++ for 32-bit Windows XP® and Windows 98 SE® compatible utilities program for manipulating, setting up, and downloading the FMB IV. This replaces the now outdated MS-DOS based programs that are normally supplied with the FMB IV (which will not work properly in the XP environment). FMBoardApps may be run directly from Windows, but it is particularly efficient when called from within members of the HrSchool program group.

FMBoardApps eliminates the need to remember complex command lines, file names and paths. It instead uses simple instructions and graphic windows to gather pertinent information from the user then uses the correct resource files to prepare the FMB IV for it's intended use. An on-line WinHelp documentation, help and troubleshooting guide is always available, complete and simple to understand. This simplifies working with the Limnoterra FMB IV.

GetNewLimits is a small self-contained program designed to be called by Capther4 (via the "*Calculate New Error-Checking Parameters*" menu item) to update the Capther4.ini file with new check limits as calculated from previously collected data in the main data files. It will use the most current data first, then next most recent, and so on, until the maximum number of data points as chosen by the user is attained. Data will automatically be added to the Capther4.ini file, replacing past data.

Process is a stand-alone program that will give a small report of how many fish were processed between certain dates. It may be called from a link in the Capther4 main menu (labeled "*Get Processing Statistics*").

AUTOMATED DATA GATHERING USING 32-BIT HRSCHOOL

HerBase and an FMB IV may be used in the field to gather length-frequency data and conserve length-stratified sub-samples from commercial landings and research projects. Alternatively, these may be obtained using the standard hardwood measuring board and recorded on a standard length-frequency sheet, then entered using HerBase. This creates the comma-delineated length-frequency and logbook file entries for that sample. For at-sea research projects, length frequency data are gathered on all species caught as well as detailed biological information from groundfish as required using the CSurvey system. CSurvey132 and an FMB IV with or without an integrated electronic balance are used to gather data about the fish caught. Using CSurvey232, navigational, environmental and hydrographical information is entered and merged with the data produced with CSurvey132, resulting in the production of all standard, archival ASCII files (for herring and all other marine fish species). Herring data are written in both herring group and groundfish group archival ASCII formats.

This data are then forwarded, along with frozen length-stratified herring sub-samples, to the central laboratory. There, detailed biological information is gathered from the fish in the sub-samples, using Capther4, a digital balance and an FMB IV to enter the data directly, conduct validity tests on data as they are acquired and write them to centrally located files via a Local Area Network. This produces the detail data file information and otoliths from each fish. The electronic logbook is also automatically updated with date processed and actual number of fish done. The otolith are then desiccated, mounted using solvent-based resin, dried and forwarded to a qualified fish age reader.

The otolith are examined by a qualified fish age reader, who determines the age and inputs it into the

data files using HerBase as each pair of otoliths is examined. HerBase does validity checks (age vs. length) as each fish is aged and warns the user if the conditions are not met. Logbook, length frequency and detail biological data may be edited at any stage using the HerBase editing facilities. Once complete, the archival data files may easily be uploaded to a general (Oracle or other) user database using an appropriate loader facility.

USING THE SOFTWARE

HrSchool

The HrSchool entry point provides a simple way to access the right routine for any job. Double-clicking on the distinctive herring school icon will launch this interface from which all the HrSchool software may be accessed via a detailed menu. Only the chosen routine is actually loaded into memory, therefore avoiding wastage of resources. Upon leaving the routine called, the user is returned to the HrSchool main screen.

When the user double-clicks on the distinctive fish school icon, the program opens to its main window which has four main menu items with, in total, eleven sub-menu items:

- Port and Laboratory Work (Appendix A image a)
  - Measure Herring At the Wharf ("Port Sampling")
  - Enter New Samples, Add Fish Ages or Edit Herring Data
  - Enter Herring Detailed Biological Data in the Laboratory
  - Exit

- Maintenance (Appendix A image b)
  - Calculate New Error-check Parameters for Laboratory Work
  - Display Herring Processing Statistics
  - Set up an FMB IV

- Research Data Gathered At Sea (Appendix A image c)
  - Record Fish Lengths and Biological Data
  - Enter And Merge Bridge Data

- Help (Appendix A image d)
  - HrSchool Help
  - About HrSchool

By clicking on the "*Port and Laboratory Work*" item then "*Measure Herring At the Wharf ("Port Sampling")*" (or pressing the *<Alt>* key and then the underlined letters "*P*" and "*M*") the user will call the HerBase facility, ready to enter catch data and fish lengths using an FMB IV.

Clicking on "*Port and Laboratory Work*" then "*Enter New Samples, Add Fish Ages or Edit*

Herring Data" or the keyboard equivalents will call the HerBase facility ready for entering fish ages as reading is done, enter length frequency samples done manually and recorded on paper or edit data already entered into the database.

Clicking on the "*Port and Laboratory Work*" then "*Enter Herring Detailed Biological Data in the Laboratory*" will call the Capther4 laboratory system, opening directly at the first data screen, ready for data entry and defaults verification or change.

Clicking on "Maintenance", then "Calculate New Error-check Parameters for Laboratory Work", will start a "GetNewLimits" session, permitting calculation of new parameters for use in the present and future Capther4 sessions.

By clicking on "Maintenance", then "Display Herring Processing Statistics", the user may access the "Process" facility which will produce a report of the number of fish gathered for detailed biological examination and those processed.

If the user clicks on "Maintenance", then "Set up an FMB IV", an FMBoardApps session will begin, permitting manipulation of the FMB IV.

By clicking on "Research Data Gathered At Sea", then "Record Fish Lengths and Biological Data", the user will directly start a CSurvey132 session.

Clicking on "Research Data Gathered At Sea", and "Enter and Merge Bridge Data", will permit data entry using the CSurvey232 facility.

The user may get information about each process by clicking on "Help" and "HrSchool Help". A WinHelp session will start with a table of contents displayed from which the user can choose items of interest about the HrSchool software.

By clicking on "About HrSchool", the user can also obtain version and other information for the copy of HrSchool being used.

HerBase

HerBase may be accessed from the HrSchool main page or directly by double-clicking on the distinctive clipboard-and-pencil icon. The first window to open in HerBase is the Files Information Form (Appendix B image a). It has one menu item, four Windows Edit Boxes, four virtual buttons and a check box.

HerBase WinHelp

Clicking on the help menu will cause a drop-down help selection menu to appear.

1. The first item on that menu will start a HerBase WinHelp session while the second will display contact information in case of serious problems. The WinHelp files are as complete as possible,

with step-by-step program use instructions, detailed format of all files (including all initialization and data files produced or updated by the program), and FMB IV and software troubleshooting tips. They include screen shots so the user may better visualize each screen.

2. The second will give contact information so one may contact the authors for answers to questions that are beyond the scope of the help files.

3. The last will cause a dialog box to appear with author, copyright and version information.

The Files Information Window Controls and Edit Boxes:

Clicking on the top button ("*Cancel*") will cancel the session, causing an orderly exit back to HrSchool. Clicking on the second ("*Set Up the Board*"), will call the FMBoardApps facility to permit initialization or direct manipulation of the FMB IV. Clicking on the third ("*Field LF*"), will send the program into a length-frequency gathering session, using a FMB IV as input device. Clicking on the last of the buttons ("*Enter or Edit Data*") will permit using HerBase as a data base editor to edit or manually add new logbook, length-frequency (from manually measured and recorded samples) or age data to the database files.

The first Windows Edit Box permits entry of the Data Year. Putting a value in this box automatically changes the values in the next three (by changing the year designator in the conventional file names) which is particularly useful when editing historical data spanning several years. The next three Windows Edit Boxes contain the following:

- The Path and Name of the Electronic Logbook File
- The Path and Name of the Length Frequency File
- The Path and Name of the Detail Biological Data File

These are automatically filled with default paths and filenames of the three data files which were last accessed and/or modified by HerBase. These paths and filenames are read from a file called defaults.log which is created on first run of the program in the default directory and updated at each session.

If the three data files do not exist they will be created as long as the path points to a valid, pre-existing path. The program may behave unpredictably if told to create files in a non-existent directory or path. If these files already exist then they will be opened for append or editing of data.

- Clicking on the "*Cancel*" button will cause the program to exit.
- Clicking on the button labeled "*Set up the Board*" will call the FMBoardApps utilities facility. This will permit testing, manipulating and re-initialization of the FMB IV. When leaving the FMBoardApps utilities facility, the program will return to the Files Information Window.
- Clicking on the button labeled "*Field LF*" will start the procedure for measuring a length frequency sample directly using the Limnoterra FMB-IV. First, the Log Data Entry Window will open, with Field Measuring options set for input of position, fishing boat and landings information. The software will then go to a Data Acquisition Window until the letters "**E**" "**N**"

"**D**" is entered via the FMB IV and sent to the computer (by triggering a "**Save Data**" sensor).

- Clicking on the "*Enter or Edit Data*" virtual button will activate the Log Information Window with the appropriate options for the editing or entry of log, length or detail data.

- When the "*Update from Last Sampler's Number*" check box is checked, the software will automatically increment Sampler's Number using the last one already on the electronic logbook file. This was found quite useful when entering several, consecutively numbered samples by the same sampler.

The Log Information Window

By selecting different options found on this window, and depending on which virtual button the user clicked to exit the Files Information Window, the user may accomplish several different tasks including:

- Enter new length frequency data using an FMB IV electronic fish measuring board as an input device (see Field Sampling Mode section further in this document).
- Enter manually gathered information or edit previously entered length-frequency data (see Enter or Edit Data Mode and Length Frequency Entry and Editing Window sections further in this document).
- Enter fish ages as otoliths are being read (see Detail Biological data Editing Window section further in this document).

Field Sampling Mode

In this mode, the sample number is automatically set to the next available number. This will not normally need to be changed by the user.

Many Windows Edit Boxes, those containing values that usually often repeat for several samples, open pre-filled with default data (what were in the last sample). (Appendix B image b) Others (those which normally need to have new values for each sample) will be blank. For consistency in data files, as in all HerBase data entry windows, characters are automatically converted to upper case.

The Sampler's name or code may be entered in the combo box labeled "*Sampled By*" or, in the case of regular samplers, chosen from the drop down list. This list is filled from the "Samplers.txt" file found in the .../texts directory to which new samplers may be added using a text editor. The convention for naming samplers in the Gulf Region Herring Group is: first initial, a period and a space then family name. Once a name is present and the user exits this Windows Combo Box (by use of the <Tab> key or mouse) the application will find the next sampler's sample number for this particular sampler and insert it in the "*Field Sample #*" Windows Edit Box (i.e. if sampler J. Bloe's last sample on file was 305 then 306 will be the default for "*Field Sample #*" Windows Edit Box). This number may be changed by the user if not correct for the sample to be entered. If the sampler has no samples listed in the log, "1" will appear as the default. If the sampler is assigned a specific range (example: J. Bloe's numbers must all be between 400 and 499), the user need only enter the required number for the lowest assigned value for the first sample (ex: 400) and this will be automatically incremented for further samples.

The "*Port Landed*" Windows Combo Box contains the name of the port landed, a comma, and the Statistical District Code for the port. The drop down list is filled from the file.../texts/ports.txt. A name may also be entered (with the comma and the proper numeric DFO Statistical District Code). If

the port is unknown the convention is to enter "UNKNOWN", a coma and the DFO Statistical District Code. For experimental projects, a port name or survey number and a numeric code in the 900's is entered (ex.: for a Mesh Selectivity Study sample landed at the fishing wharf at Escuminac, "Escuminac,908" or for a sample taken during a Groundfish Research Survey with survey code N106, "N106,905")

Codes in the 900 range are all used for designating research samples and have been assigned as follows:
900 - Research Unspecified
901 - Herring Acoustic Survey
902 - Herring Juvenile Acoustic Survey with midwater trawl
903 - Herring Juvenile Acoustic Survey with bottom trawl
905 - GroundFish Research Surveys
908 - Herring Mesh Selectivity Study
More information about the type of research may be entered in the comments section of the logbook entry.

The next three Windows Edit Boxes are for the sampling "D*ate*" entered as (day) "*dd*", (month) "*mm*", and (year) "*yyyy*". These may be entered as one or two digits, with or without leading zeros or spaces, but if leading zeros are added they will be removed by the program and replaced by a space character for consistency an compatibility with certain programs often used to study the files.

Next is the "*Experiment Type*" Windows Combo Box. This list is filled from the file.../texts/Extype.txt. The string preceding the comma is for user information, with the value after the comma being what is actually recorded.

The "*Latitude*" and "*Longitude*" Windows Edit Boxes should be entered as Degrees, Minutes and Hundredths of minutes as a six digit string (without the decimal point - which is implied). They will, on exit, automatically left-justify with zeros to 6 characters, if less than 6 are entered by the user. Loran C coordinates may also be entered. As with Latitude-Longitude, they should be entered without decimal point.

The data for the box labeled "*NAFO Area Fished*" is normally entered as alphabetic characters but numeric code equivalents may be entered and will be translated to alphabetic. On exit of either the Latitude or Longitude Windows Edit Boxes, if the Latitude and Longitude are greater than the minimum values (specified in the HrSchool .../texts/defaults.log file) a routine finds the fishing location's NAFO area and sub-area which will appear as the default value in the next box. If the Latitude and Longitude do not work out to values found in the file.../texts/NafoArea.txt, this Windows Edit Box will be set to a default value of "U". If they are of the order of LoranC values (less than the minimum Latitude and Longitude values for the Gulf of St Lawrence) or are left blank, the NAFO Area Fished Windows Edit Box will remain at the value of the last sample entered unless changed by the user.

In the Windows Edit Box labeled "*Boat Name or C.F.V.N.*", the user may enter the name of the fishing boat or its Canadian Fishing Vessel Number ("CFVN"). Up to 20 characters may be entered.

The Windows Combo Box "*Gear*" is loaded with a list obtained from the file.../texts/Gears.txt. This contains gear codes for commercial and research fishing. An asterisk (*) in the gear code

designates a research gear.

The "*Mesh Size*" Windows Combo Box list is filled from the file../texts/mesh.txt. This list has the common mesh sizes as English measure (i.e. 2&5/8), a dash, the metric equivalent, a comma, and the English measure as a decimal number, followed by another comma. The English decimal equivalent is what is written to the file. Mesh may be entered as English decimal without any commas (i.e. 2.63) or in metric (i.e. 57) and if it exists on the list, the list entry will fill the box on exit. If the mesh is not on the list then the box color will change to red on exit (to indicate possible error) but the value in box will be written to the log file when it is saved.

The "*Species Weight*" Windows Edit Box is used to enter the weight for the species of fish that the log entry is for. In the Gulf Region this weight is recorded in pounds and if data was received in another unit of measure, clicking the radio button (in the following group of pound, kilo, tons, etc) will on exit of the radio group cause the weight to be converted to pounds. The button will then be reset to pounds.

The Windows Edit Box labeled "*Measure Sampling Protocol*" is set by default "Total" (which is the standard method for measuring herring). If another type of measure is used (i.e. fork length, standard length or some other) then it should be entered here. This will be written to the file as entered.

The "*Save*" Windows Edit Box is used to enter the number of fish to be saved per length interval as per the stratification scheme for this species and type of sampling. This is used both to document sampling procedure and, when using the field sampling function capabilities, set the value for the function which notifies the user to keep fish for subsequent sub-sampling.

The Windows Edit Box labeled "*Per*" is used to enter the length interval size. It can be either 0.5 or 1.0 cm. This is used by the program to determine the interval fish measurements must be tallied into. When entering data previously recorded manually, the entry window interval is also determined by this value (start lengths of 0.5, 1, 1.5 for 0.5 cm interval or 1,2,3,4 etc for 1.0 cm interval).

Clicking on the virtual button labeled "*Measure Fish*" will cause the program to exit the current window and display a new one with a message box reminding the user to check the FMB IV if it is on (Appendix B image c). This will remain displayed until the user clicks upon its virtual button (labeled "OK"), the program will continue, producing a new message box with the path and filename of the backup file(Appendix B image d). The program will, once the user clicks on the virtual button, continue on to the Fish Measuring Window (Appendix B image e) and go into an endless data gathering loop which may be exited only by triggering the sensors "E" "N" "D" (and <Save Data>). The user will be prompted to save fish for a sub-sample when necessary and all lengths will be compiled into a standard length frequency and to a list of individual fish lengths in the backup file.

Clicking on the virtual button labeled "*Save*" will save the logbook data without compiling a length frequency for that sample.

Clicking on the virtual button labeled "*ClearForm*" will clear the entire form so the user may start a sample with totally different data to be entered.

Clicking on the virtual button labeled "*Enter #'s at Length*" will permit edit of length frequency data previously gathered.

Clicking on the virtual button labeled "*Exit*" will cause the program to shut down in an orderly exit.

The virtual buttons may also be activated by pressing down the "*Alt*" key and the letter underlined in the button's label.

Enter or Edit Data Mode

When the user clicks on the File Information Window's "*Enter or Edit Data*" virtual button (or simply presses the "*Enter*" key since that is the default button) the user will enter the Log Data Entry Window in the data entry and editing mode (Appendix B image f).
Most log data are input in identical fashion as when measuring directly using the FMB IV. One obvious difference is the absence of the "*MEASURE FISH*" virtual button. Another rather obvious difference is, about one third down the form, the presence of a groupbox of three Radio Buttons allowing the user to choose between the following options (in typical groupbox fashion, selecting one un-selects the currently selected option):

- Add New Data
- Search By Sample
- Search By Field

Add New Data:

This radio button is automatically selected when the Log Window is opened in "*Enter or Edit Data*" mode. Selecting this option will permit the entry of Electronic Logbook and length frequencies data for new samples manually recorded on paper. There is a virtual button labeled "*Enter #'s at Length*" in the lower right area of the form. Once the Electronic Logbook ("Header") information is entered, clicking on this virtual button will open the Length Frequency Entry and Editing Window (described further in this document).

Search By Sample:

This function is useful for editing the Electronic Log, Length Frequency data and editing the detail biological data or adding new fish age data for a particular sample. When selected (and the virtual button labeled "*Find*" is clicked (Appendix B image g) or the keyboard's <*Enter*> key is pressed), the sample matching the sample number entered is then found and the electronic logbook is displayed on the form.

Next to the "*Find*" button are two virtual buttons labeled "*Previous*" and "*Next*". These permit the user to navigate through the log to the proceeding or next sample when performing edits on the files.

Modifications to the log file are made by changing the values on the screen and clicking the "*Save*" virtual button. Editing of the detail data file (which includes addition of age data to the file) is performed by clicking the "*Edit Detail*" virtual button which appears in the lower right quadrant of the window. This opens the Aging and Detail Data Editing Window with a data line of the selected sample

present in the window ready to edit. Clicking on the virtual button labeled "*Age Detail*" will also open the Aging and Detail Data Editing Window, ready to input fish ages onto the file.

Clicking the "*Enter #s at Length*" virtual button will open the length frequency file with the currently selected sample's length frequency numbers at length data present, ready for editing (see "Length Frequency Entry and Editing Window" section below for more details).

Search By Field:

When selected, this permits searching through the log file for a sample containing certain strings in one or several fields. All searchable fields have their labels printed in bold for easy reference (Appendix B image h).

When searching by field pressing the "*Find*" or "*NEXT*" button has an identical effect. The application will locate the first log entry containing an occurrence of all the strings entered in the search fields and then clicking on the "*NEXT*" (or "*Find*") button the next one on the file. A message box appears warning when the end of the file is reached. If search criteria are to be changed the "*CLEAR FORM*" button, present only in this mode, may be clicked and new search criteria entered.

There is no "*PREVIOUS*" button in this mode and to return to a record that has been passed, the search must be restarted. The editing features work the same as in the "search by sample" mode and this form also has both the "*Edit Detail*" and the "*Age Detail*" buttons.

Length Frequency Entry and Editing Window

By clicking on the "*Enter #s at Length*" virtual button, the user will enter the numbers at length entry and editing window (Appendix B image i). In this window, there are a series of Windows Edit Boxes where the user may enter numbers at age data recorded by hand on paper or correct errors discovered in length frequencies. The first box is in effect a Combo Box, which may be used to set the starting interval size. When the user either chooses a new value for this box from the drop-down list or types one in, the other values for the 100 intervals displayed are automatically re-adjusted accordingly. The user then need only type in the appropriate numbers at length for each length at which fish were measured in the sample.

At the top of the Length Frequency Window, there are four virtual buttons. The first is labeled "*Save*". It, when clicked, will cause the program to save the data present in the various fields of the form and to return to the Log Entry and Editing Window. The next is labeled "*Quit Without Save*", and, as its label implies, it will cause the application to abandon any changes made to the data and to return to the Log Entry and Editing Window. A third virtual button is labeled "*Graph lf*" (an abbreviation of "Graph length frequency"). Clicking on it will cause the application to call the default text editor (usually Windows NotePad®) and pass onto it data permitting a quick, if gross, graphing of the length frequency histogram (Appendix B image j). The rightmost virtual button also calls the default text editor and graphs the length frequency histogram, but converts the data to inches before graphing (which may be useful when demonstrating results to people involved in the industry, since they are often used to working fish lengths in the English rather than metric system).

Detail Biological Data Editing Window

Once a sample is located in the electronic log file, the user can click on the "*Age Detail*" or "*Edit Detail*" button to enter the detail data editing window (Appendix B image k). This window may be used for entering fish age data or otherwise viewing or editing detail biological data files. Some of

the data displayed in this window are common to both detail and log files (Sample Number, date,). These are considered "Thread" data used to maintain a consistent link between a sample's data which is spread among several individual files. For this reason, these, as well as fish number, cannot be changed by using the Detail Biological Data Editing Window form. If these must be changed it must therefore to be done in the Log editing Window (except for fish number which must be carefully edited using a text editor once assured that nobody else is using the file at that time). When this common data are edited in the Log Window and the "*Save*" button is clicked, the data on the Length Frequency and Detail files is also automatically changed to match (therefore preserving the integrity of the Informatics Thread). The Ager code is set to the initials of the default ager but may be changed to any 3 letter or numeric code.

By default, when in "age detail" mode, the Detail Biological Data Editing Window does not display most of the biological data for each fish. This is done since this window's primary use is to enter fish ages as they are determined from the otoliths taken from the fish. Hiding this information guards against the possibility of ager bias that might inadvertently occur if the ager saw the length and weight data before examining the otoliths. Also, before writing data to file, the age entered is compared to the fish length and errant data are flagged by use of a message box and an audio warning for user verification before being written to file (Appendix B image l). The user need only click on the "*Display All Data*" virtual button to have the data for a fish displayed (Appendix B image m). It may then be edited. Error checking is carried out on the data before it is written to file. The user may navigate through the sample's data lines by clicking on the "*Next Fish*" and "*Previous Fish*" virtual buttons. Besides the common data members and the detail data file data, there are boxes displaying the "*log Comment*" from the log file and the total number of fish on file aged and not yet aged for the year (according to the log file). The "*Age Comment*" field, although short, permits the ager to document, if a bit cryptically, notable variations on the aging. For instance, "4?5" could be entered to indicate some uncertainty regarding the fourth annulus which was counted nevertheless and "3C4" could be used to indicate a structure counted as a check after the third annulus.

CSurvey

CSurvey opens to a main window with a three item main menu (Appendix C image a).

- Clicking on the first menu item, labeled "Choose Activity" and will open a four-item sub-menu (Appendix C image b).
  - The topmost is labeled "*Measure Fish*". It will call the CSurvey132 utility (described in the next section) directly at its Defaults Verification Form to begin the entry of biological data about the catch using direct-entry devices including an FMB IV electronic fish measuring board and optionally, an electronic balance. At the end of processing, the user will be returned directly to the CSurvey main screen.
  - The second is labeled "*Enter Navigational Data*". If clicked, it will open the CSurvey232 facility (described after the next section) to permit entering navigational, hydrographical, catch and gear information and produce final format ASCII files. At the end of each set, the program will be return to the CSurvey232 main screen so more sets may be entered. If this is not desirable at the time, the user may exit the screen by clicking on the "*Exit*" menu item or clicking on the "x" icon in the upper right corner of the window to return to the CSurvey main screen.

- The third, labeled "*Set Up the FMB*" which will call the FMBoardApps facility, described in detail further in this document, to permit program and manipulate the FMB IV electronic fish measuring board. Upon exit of this facility, the program will return automatically to the CSurvey main window.
- The fourth, "*Exit*", will cause the orderly shutdown and exit from the program.

- Clicking on the second main menu item, labeled "*Help*" will cause a CSurvey WinHelp session to start with information on CSurvey, the two routines it calls, file formats and other pertinent details.

- The third main menu item is labeled "*About CSurvey*". Clicking on this will cause a message window to be displayed with information about version, build, author and copyright(Appendix C image c).

CSurvey permits the work to be done in two distinct steps. First, fish are measured and other biological data gathered immediately after each set using the CSurvey132 facility as accessed via the "*Measure Fish*" menu item. After all the fish is processed, the information gathered must be united with catch, navigational and environmental data to produce final-format files. This is done by clicking on the "*Enter Navigational Data*" menu item, launching the Csurvey232 routine which will permit entry and assure proper coding of information, then output standard files.

CSurvey132

This facility may be accessed via the CSurvey "*Measure Fish*" menu sub-item or may be run directly by double-clicking on the distinctive CSurvey132 Coast Guard Ship icon ("Blue sky" background) using the mouse or yet pressing the keyboard's <Tab> and arrow keys until the icon is highlighted, then pressing the <Enter> key. The wait cursor will then be displayed while the program loads. The program's main window is painted in maximized mode and contains a two item main menu (Appendix D image a).

Csurvey132 was written as much a possible to use standard 32-bit Windows® protocol so much of its operation will seem familiar. The commands sent from the FMB IV are, as much as possible, the same as those used when working with Capther4 to avoid confusion for those working with both systems. The system uses communications port COM1 for communicating with the FMB IV, therefore, it is advantageous that the host computer have a second serial port if direct fish weight entry via an electronic balance is desired and or a USB or PCI bus port that may be used for attaching a pointing device (or, yet again, an integral joystick or touch pad pointing device). Otherwise, a mouse will normally not be available and commands will have to be entered via the keyboard shortcuts.

The program main window can be set to standard mode or minimized mode if required by clicking the appropriate icon, but should normally be left maximized to enable the textual prompts to attain maximum efficiency. As in other Windows® applications, the mouse may be used to select a menu item or items may be selected by pressing the <Alt> and using the arrow keys to highlight the menu items at the top of the window. Pressing the <Alt> key and the letter on the keyboard corresponding to the one underlined in the menu items also selects that item. Once the menu is highlighted, the user can alternatively select an item by using the arrow keys to move the highlighted

area until the desired function is selected. Pressing <Enter> or typing the underlined letter in the desired function will activate it. Once the menu is highlighted, the user can also select by using the arrow keys to move the highlighted area until the desired function is selected. Pressing <Enter> or typing the underlined letter in the desired function will activate it.

The first drop-down menu choice is "Choose Activity" which has three items (Appendix D image a):

- "*Measure Fish*". This will start a fish measuring session..
- "*Set Up the FMB*". This item will launch a Windows interface that replaces various Limnoterra® Software modules that were in the past used to set up the Limnoterra FMB-IV®. Some functions will reset the baud rate and communications parameters or initialize the FMB with its sensor definitions, allow testing of the board, etc...
- "*Exit*" menu choice will close the program and exit to the Windows® Desktop.

The "*Help*" drop-down menu choice contains two items:

- "*CSurvey132 Help*" will start a Windows® Help session beginning with the Csurvey132 WinHelp Contents page from which the user can go to or do an indexed search for a subject.
- "*About CSurvey132*" will print a window containing Copyright and version information.

Selecting the "Choose Activity" menu then the "Measure Fish" menu item, will first cause the Set and Species Information window to appear asking for specific inputs from the user (Appendix D image b). This form contains six Windows Edit Boxes, one Windows Combo Box and two virtual buttons. Moving from one edit or combo box to the next using the <Tab> key or selecting each one with the mouse, the user can enter the pertinent data in each field. These include:

- "*Day*" set was made (default is the current day as supplied by the computer)
- "*Month*" set was made (default is the current month as supplied by the computer)
- "*Year*" set was made (default is the current year as supplied by the computer)
- "*Survey Number*" (default is that entered last session)
- "*Set number*" (default that entered last session)
- "*Stratum*" (defaults to that entered last session)
- "*Species*" (a drop-down Windows Combo Box containing a list of all fish species found in the Gulf of St Lawrence)
- A Virtual Button labeled "*Continue*"
- A Virtual Button labeled "*Exit*"

Typing a few of the first letters of the common name of a fish species into the "*Species*" Windows Combo Box and pressing the down key will bring up the first species with a common name starting with those letters. Species with several often used common names are usually entered more than once. French and English common names for the same species are often both on the list (or may be added), so the user may choose the one which is most familiar. If the right species is not immediately brought up, using the down arrow key will permit viewing other species names in the alphabetically sorted list beginning with the same letters.

Once the all the form is filled, the user clicks on the "*Continue*" button or presses the <Enter> key to continue. Clicking on the "*Exit*" button or tabbing until it becomes highlighted then pressing the <Enter> key will cause the program to abort and return control to Windows.

If the user chooses to continue, the Sampling Options Window is displayed (Appendix D image d). Here the user may verify that the parameters set are what will be needed to process the sample and

change any that are not what is required. The form includes ten Windows Edit Boxes two virtual buttons and a Windows Check Box:

- In the first Windows Edit Box, the common name of the species chosen is displayed for user verification that the right species was chosen in the previous screen.
- The numerical species code is displayed in a second Windows Edit Box for further user verification in case the common name is misleading.
- The standard interval size for length frequencies of this species is displayed in a third Windows Edit Box for verification and may be changed if another interval is preferred.
- The default number of specimens to keep per interval for that species is also displayed in a fourth Windows Edit Box. This may also be changed if a non standard sampling level is desired.
- The fifth Windows Edit Box sets the software up to do regular or sexed length-frequencies. If its value is "YES", male, female and indeterminate sex individual lengths will be each compiled into separate frequencies. (To permit this, the user must first enter a fish's sex into the FMB IV, then measure the fish). If this Windows Edit Box is set to "NO", then all fish lengths for this species will be compiled into a single frequency.
- The sixth Windows Edit Box is used to set the software to do or not do detailed biological sampling during the length-frequency gathering process. If it is set to "YES" the program will prompt the user, when required, to enter the detailed biological data normally gathered from fish at sea during research surveys. If set to "NO", the program will just prompt the user to keep the specified number of fish for processing at a later date. This sample will then be labeled and frozen for transport to a central laboratory where processing will occur at a later date.
- The seventh Windows Edit Box contains the number to be assigned to the next fish/otolith to be sampled, if indeed sub-sampling is to be carried out at sea. This is the number that will be on the otolith container (envelope or vial) and also be printed out on the list of lengths file and eventually on the biological data file. This number is updated when the program is exited normally, but may have to be manually changed if the program was exited in an abnormal fashion last time or if this species was sampled at another workstation at the end of the last set.
- The eight Windows Edit Box permits switching from standard protocols to those special sampling protocols put in place in 2001, in order to comply with special sampling requirements in use by groundfish scientists for Cod, American Plaice, and several species normally measured into a sexed length-frequency. When this Windows Edit Box has a value of "YES", these special sampling protocols will be followed. Otherwise, traditional sampling protocol will be followed. A Windows Message Box will be displayed to warn the user if special protocols are in effect for the species in question.

  The special protocols in effect as of year 2001 are as follows:
  - American Plaice:
    - 1/cm/sex for females <= 40cm and males <= 35 cm
    - 2/cm/sex for females > 40 cm and males > 35 cm
  - Winter Flounder, Yellowtail Flounder, Dogfish, Skates, Redfish:
    - 1/cm/sex
  - White Hake:
    - 2/cm/sex
  - Halibut:
    - All fish sub-sampled

- Witch Flounder, Turbot, Windopane Flounder:
  - 1/cm (regardless of sex)

- Atlantic Cod:
  - All fish over 70 cm sampled

- The ninth Windows Edit Box displays the default path for the main file. This may be changed if the user should prefer it was written elsewhere.
- The tenth Windows Edit Box displays and permits correction (if necessary) of the backup file path. The length frequency intermediate files (.LF1) will be written to the main file path, and the list of lengths files will be written to the Backup Path as they also act as backups of data. Normally, the backup path points to somewhere on a removable medium drive (diskette, CD Writer, memory stick or other drive). This will allow recovery of data in the unlikely case the computer should go down during processing and could not close the current file properly.

Using the mouse to click on the "*Continue*" button or pressing the <Enter> key will accept data as displayed and force the software on to the fish data gathering phase.

At this point, the screen clears and a message box appears prompting the user to turn on the FMB IV. An audio prompt also plays, telling the user to "*Turn on the FMB IV Now*" (Appendix D image e).

If this Windows Message Box is passed and the Limnoterra FMB IV is not on and plugged into the computer, the program will freeze up and the host computer will probably have to be shut down and booted up again due to communications port drivers crashing. After checking the input devices, the user need only press <Enter> or click on the OK button.

Working In the Fish Processing Window

At this point the Fish Processing Window becomes active. The program is then in an endless data-gathering loop. From this point on and until all the fish are processed, the user need not touch the keyboard. All input is via the FMB-IV. Data are automatically pre-coded by the FMB IV with lower-cased alphabetic pre-codes, and the computer then does the necessary parsing, final coding and formatting of data as it is received.

The user is prompted using textual and audio prompts to measure the length of a fish (or in the case of sexed length frequencies, to enter sex and length of a fish). The user then need only place the fish upon the FMB-IV, snout against the headboard, and place a magnetic probe, generally attached to a knife's or scissors' handle on the board surface so that it is over the stenciled measuring line and it's centering line is aligned with the fish's tail at the appropriate place (fork or total length as the case may be). The length is recorded by the FMB-IV, transmitted to the computer and is displayed on the monitor. The user is prompted to keep or sub-sample the fish if required according to the sampling protocol as chosen via the forms displayed prior to the beginning of actual sampling or the special sampling protocols for specific species as detailed earlier.

Should the user realize that an erroneous measurement has been entered, it may be removed by entering "U" "N" "D" "O" (and a <Save Data>) immediately following the original entry. All traces of the erroneous entry will be removed from tallies, the compiled length frequency and the backup list-of-

lengths and detailed data backup file.

The program increments the fish number automatically after each individual fish is completed, gives the user feed-back via textual and audio prompts, opens for append, writes data to and closes the list of lengths and detailed biological data intermediate format file. This virtually assures that, regardless of malfunctions, no data may be lost. Even if the computer should develop a major problem in the short period when the list of lengths and detailed biological data file is still opened, the removable media may be read on another machine using data recovery software (programs that search all data on a disk for specific data sequences and save selected data to proper files, such as "Grep"). The length is added to the length-frequency which is compiled in memory to be written at the end of the sample.

Detailed biological information may be entered via the FMB IV by triggering the following sensors prior to entering the actual data value:

- the sensor labeled "*Male*" is used to indicate the fish was male (pre-codes data with a "m")
- the sensor labeled "*Female*" is used to indicate the fish was female (pre-codes data with an "f")
- the sensor labeled "k" is used to indicate that sex could not be determined
- the "*Weight*" sensor is triggered prior to entering fish weight by hand into the FMB IV. It will cause a lowercased "w" to be recorded, indicating to the software that the number following it represents body weight. If using direct weight input from a digital balance, the user need only press the balance's "Print" key when prompted by the software to do so.
- the "*h*" sensor is triggered prior to entering a measure of stomach fullness
- the "*y*" sensor is triggered prior to entering a measure of parasitic infestation
- the "STAGE" sensor is triggered prior to entering a maturity stage (pre-codes data with a "g")
- the "VESSEL ID" sensor is used prior to entering a gonad weight (pre-codes data with a "v")
- the "LENGTH #2" sensor is used to enter a fork length as a secondary length measure, followed by a new length entered via the measuring line (pre-codes data with a "b")
- the "SAMPLER" sensor is used to indicate a liver weight is to be entered (pre-codes data with a "p")
- the sensor labeled "LOCATION" is triggered prior to entry of an intestine weigh (pre-codes data with a "c")
- the sensor labeled "STATION" is used before entering a head weight (pre-codes data with a "t")

Using these codes, the user may easily enter detailed biological data gathered during at-sea surveys.

Each fish is measured and kept/sub-sampled as required in sequence until all fish are processed, then the user need only trigger the "**E**", "**N**", "**D**", and "Save Data" sensors via the FMB-IV instead of a fish length to exit the fish data gathering loop. Length frequency data are written to the intermediate format (*.lf1) file using the path and name entered in the previous screens. The software then updates the defaults file so the data used for the session will become the defaults for the next one. CSurvey132 then returns to the main window and waits for the user to choose an option from the menu.

CSurvey232

Users may access the navigational, hydrographic and catch data entry facility via the CSurvey "Enter Navigational Data" sub-menu item or by double-clicking on the CSurvey232's distinctive red

diskette icon (which may be placed on the desktop for convenience) using the mouse or yet, by pressing the keyboard's <Tab> and arrow keys until the icon is highlighted, then pressing the <Enter> key. The wait cursor then appears and a welcome audio message is played (if the host computer has sound-producing capabilities) while the program loads. Then the program's main window is painted in maximized mode (Appendix E image a). The first window contains a main menu with two items:

- "*Choose Activity*"
- "*Help*"

The program window can be changed to standard mode or minimized mode if required by clicking the appropriate icon in the upper right corner of the window, but should normally be left maximized since forms were designed to be displayed that way. As in other Windows® applications, the mouse may be used to select a menu item or items may be selected by pressing the <Alt> key to highlight the menu items at the top of the window. Pressing the letter on the keyboard corresponding to the one underlined in the menu items then selects that item. Once the menu is highlighted, the user can also select by using the arrow keys to move the highlighted area until the desired function is selected. Pressing <Enter> or typing the underlined letter in the desired function will activate it.

The first drop-down menu item, labeled "*Choose Activity*" also has two items:

- "*Enter Set Information*". This will start a data entry and merging session..
- "*Exit*" menu choice will close the program and exit to the Windows® Desktop.

The second menu item, labeled "*Help*" contains two items:

- "*CSurvey Help*" will start a Windows® Help session.
- "*About CSurvey2*" will give Copyright and version information.

Selecting the "*Choose Activity*" menu then the "*Enter Set Information*" menu sub-item, will cause a first Windows® form to appear asking the user to verify defaults set during the last session and correct them if necessary.

Set and File Information Window

The Set and File Information Window lists several default data identifiers (or "data thread" items) for verification and correction, if required (Appendix E image b). These include the survey number (default is the survey number as entered during the last session), Set number (the set number entered last session displayed), vessel name and CFVN (commercial fishing vessel number – which also defaults to that entered during the last session). There's also a drop-down box for choosing the (Herring commercial codes) type activity code and (standard groundfish commercial codes) survey activity code which are used in the Herring Electronic Logbook entry for the set. An edit box allows input of Alpha-numeric or alphabetic stratum name or label. This can be as much as 39 characters long but the first three only will be used for groundfish format files' stratum (which is numeric). Four more edit boxes allow input of the path to the intermediate list of lengths (.dat) and length frequency files (.lf1), as well as the master and backup copies of the final files. Moving through the edit boxes using the <Tab> key or mouse, the user can fill or change the defaults printed in each field if necessary.

Once the form is filled, the user need only click on the "*OK*" button or press the <Enter> key to continue. Clicking on the "*Cancel*" button or tabbing until it becomes highlighted then pressing the <Enter> key will cause the program to abort and return control to the Windows Desktop®.

Station Card Data Window

If the user chooses to continue, another Windows form will be displayed (Appendix E image c). The user may use it to enter the navigational, environmental and hydrographical information pertaining to the set, position, gear and environmental parameters:

This form is used to enter details of gear, positional, navigational, hydrographical, and total catch information. To do so, it has 14 rows containing a total of 40 edit boxes and combo boxes.

The first line of edit boxes echoes and permits editing of the basic set information already entered and allows entry of the date. The default date is that entered during the last session.

The second line of entry boxes has an edit box labeled "*Unit Area*". If Start Latitude and Longitude for the set are available, as would normally be the case, the NAFO subunit area value for the location of the set will be determined automatically by the software as soon as the cursor leaves the Start Longitude edit box and will appear here. NAFO subunit area auto entry is available for all of the subunit areas in 4T, 4Vn, 3Ps, 3Pn as well as major areas 4R,4S and 4W. New areas may be determined by adding the appropriate information (as described in the HerBase WinHelp) to the Nafoarea.txt file found in the Texts subdirectory. If the location of the set is for some reason not available as Latitude and Longitude, or the areas are outside the areas mentioned above, the NAFO Unit Area will have to be manually determined and entered. On the same line, there is also a drop-down box which will allow choosing the Experiment type from a list. The last Experiment type entered will appear as a default value.

The third row starts with ship's speed. In order to standardize and eliminate the possibility of entry errors (since in some cases in the past these data were entered without keying in the decimal period, it being implied while in others a period was keypunched), there are two boxes. To make sure data are entered in a consistent manner, the first entry box of ship's speed is for whole numbers only and the second is for entry of tenths of a knot. To the right of this, there is a drop-down combo box for entry of the code for the method used to determine speed. Here again, the last value entered will appear as a default value.

At the beginning of the fourth line is a drop-down combo box which allows the User to pick the experimental gear type directly from a list. To the right of this is another for choosing the mesh size (which is listed in inches and millimeter equivalent). Once again, the last values entered will automatically become defaults for the following session.

The fifth line is comprised of a drop-down combo box for choosing auxiliary equipment the trawl may be equipped with and which could affect the trawl's efficiency.

The sixth line contains two edit boxes which permit entry of the distance towed (whole numbers in the first box, decimal in the second) and a drop-down combo box permitting the choice of the method used to obtain this figure. The combo box will default to the last value entered.

Below this, is a drop-down combo box which permits choosing the code for the direction of the wind.

On the eighth line is a drop-down combo box used to choose the proper code for the wind's force.

The next line contains another drop-down combo-box for entry of the code representing tide and current in respect to the ship. This is followed by two edit boxes for entry of the time the tow started and ended. Times may be entered with a colon or without (12:12 or 1212 are both correct).

Line ten has four edit boxes for entry of start and end latitude and longitude. These are entered as "DDMMhh" or Degrees, minutes and hundredths of minutes. No period or other separators are entered (ex. "461432" would be entered for 46° 14.32´ North and "643250" for 64° 32.50´ West).

On the following line, start and end depth for the tow may be entered (whole number in the first edit box, fractions in the second). There then follows two edit boxes for entry of surface and bottom temperatures.

On the twelfth line, Bottom salinity may be entered in the first edit box, then bottom type may be chosen from the list in the drop-down box and light level (Secchi disk) entered in the rightmost edit box.

Line thirteen contains edit boxes includes (starting from the leftmost) one for the number of different invertebrate species caught in the tow, one for the number of fish species caught, then two for entry of the weight of fish caught (in kilograms and tenths of kilograms).

The last line contains an edit box is for entry of comments about the sample the user would like to record and/or make known to the technician who will process the sample in the laboratory at a later date. These (maximum of 85 characters) will be written to the herring electronic logbook file and be displayed before detailed processing of the detailed biological sub-sample of herring begins.

Two virtual buttons can be found on the bottom of the form: The one on the left is labeled "*OK*" (the default) and the one on the right is labeled "Cancel". Clicking on the "*OK*" button (or simply pressing the <Enter> key) will cause the program to continue on to the next form. Clicking on the "*Cancel*" virtual button (or pressing the <Tab> key until it is highlighted and then pressing the <Enter> key) will cause the software to abort processing and return to Windows without writing any files.

Once the third form has been filled out and the "*OK*" virtual button activated, the software will read the two appropriate intermediate files (.LF1 and .DAT files) located on the path provided in the previous form and produced while sampling fish using CSurvey132.

Species Specific Data Entry Screen

Once it has read enough from the two intermediate files to identify the first species processed in that set, the software will generate a fourth form to allow entry of more detailed information about the catch and sampling of it (Appendix E image d).

The first line has an edit box in which will be displayed the common name for the species (as chosen by the sampler when measuring the fish).

The second line has an edit box in which the sampler's name may be entered. The convention is to enter the person's first initial followed by a period and a space, then the person's family name.

The third line contains, firstly, a drop-down combo box using which the user may choose the grouping code from a list, then another for entering the type of measure used.

The fourth and fifth line is in two columns and the natural movement (using the "Tab" key to move the cursor from line to line) is first down the leftmost column then down the rightmost.

The leftmost column, in line four, has an edit box for entry of the weight caught of this species and in line five, one for the weight sampled of this species.

The rightmost column, in line four, has an edit box for entry of the number of baskets caught and in line five, one for the number of baskets (or tenths thereof) sampled.

The sixth line has two virtual buttons. Activating the "*OK*" button by clicking on it's surface or highlighting it and pressing the <Enter> key will cause the program to merge all necessary data entered so far and write the entries for that species in the main data files. Activating the "*Cancel*" button will cause the program to exit without processing any data.

This fourth form will be re-created each time a new fish species is encountered on the intermediate (.LF1 and .DAT) files. Species common name will automatically be changed and the sampler's name will default to the last one entered until the end of the intermediate files are reached. Once the ends of the intermediate files are reached, the program will write the data pertaining to positioning, hydrographical and environmental data to the appropriate files and terminate, returning to the main window.

If the .LF1 and .DAT files do not exist, instead of generating the Species Specific Data Entry Screen the user is asked if the software should only write the set's positional, hydrographical and environmental information or abort. The user should choose to abort if the intermediate files are for some reason not on the specified path but do in fact exist (for instance, if they were not copied from another machine used to host CSurvey132 during sampling). If the set was null and a record of the set needs to be on file, then the user should choose to write the information to the main files.

Capther4

Capther4 may be accessed via HrSchool's "*Port and Laboratory Work*" "*Enter Herring Detailed Biological Data in the Laboratory*" sub-menu or directly by double-clicking on it's distinctive computer-FMB IV-and-Balance icon, a copy of which may be placed on the desktop.

The Capther4 Opening Window

The program's main window is painted in maximized mode, and contains a two item main menu (Appendix F a). Although designed to run in this mode, the program window can be set to standard mode or minimized mode if required by clicking the appropriate icon. As in other Windows® applications, the mouse may be used to select a menu item or they may be selected by pressing the <Alt> and using the arrow keys to highlight individual menu items and pressing <Enter> or yet, once the menu is highlighted, pressing the letter on the keyboard corresponding to the one underlined in the menu items.

The first drop-down menu choice is "Choose Activity" which has four items:

- "*Enter Data*". This will start a processing session starting with the Sample Information Window as described below.
- "*Set Up the FMB*". This item will launch FMBoardApps to permit resetting the baud rate and communications parameters or initialize the FMB with its sensor definitions, allow testing of the board, etc. prior to sampling. The program will return to the Capther4 Opening Window once FMBoardApps terminates (Refer to the FMBoardApps section for information about this software).
- "*Calculate New Error-Checking Parameters*" will run the stand-alone program "GetNewLimits.exe". See Appendix F, image k) for a screen image and GetNewLimits section further in document for further details. It will statistically extract new error checking limits from previous years' data files and produce a new version of the "Capther4.ini" initialization file.
- "*Get Processing Statistics*" will run "Process.exe" to provide information about status of sample processing during part or all of any month. See Appendix F, image m) for a screen image and the Process.exe section further in this document for further details.
- "*Exit*" menu choice will close the program and exit to the Windows® Desktop.

- The "*Help*" drop-down menu choice contains two items (Appendix F, image b):
- "*Capther4 Help*" will start a Windows® WinHelp session.
- "*About Capther4*" will give Copyright and version information (Appendix F, image c).

The Sample Information Window

Selecting "*Choose Activity*" then the "*Enter Detail Data*" menu item, will first cause a form to appear asking for specific inputs from the user to be used to locate the sample in the electronic logbook file from which more details will then be gathered (Appendix F, image d). Moving through the edit boxes using the <Tab> key or mouse, the user can fill each field by typing from the keyboard:

- The "*Day*" field requires day of capture (entered as a one or two digit number).
- The "*Month*" field requires month of capture (as a one or two digit number).
- The "*Year*" field requires the year of capture (as a four digit number).
- The "*Sampler*" field is for input of name of the sampler that took the original port or sea sample. (By convention, Gulf Fisheries Center personnel enter one initial, followed by a period and a space then the last name of the sampler). All letters will be converted to upper case automatically for consistency.
- The "*Sampler's Number (or Set Number)*" field requires input of the unique number generated by the sampler in the field. It may be alphanumeric or numeric (Gulf Fisheries Center staff use numbers only). The field is 5 characters long. Set number is entered in the Sampler's number input box in the case of research survey samples.
- The "*Port (or Survey Number)*" field is used to input of the name of the port from which the commercial sample was taken. In the case of research vessel data, the survey number or identifier (example: N245) is entered instead of the name of the port. The "Port" field is 20 characters long.

Below these edit boxes, there is a check box labeled "*Use Audio Prompts*". If audio prompting is for some reason undesirable, the user need only uncheck this box.

The next four edit boxes contain the default paths and filenames (saved from the last session) of the logbook file, the main detail data file, the backup file path and the path and filename of the file where the data obtained for fish infected with the parasitic fungi Ichtchyophonus hoferi will also be saved. If the default settings are changed, the new settings will be used during the current session and be saved before the program exits becoming the new defaults the next time the application is launched.

Once all fields have had data entered, pressing <Enter> or clicking with the mouse on the "*OK*" button will begin the logbook search unless some vital information was not entered, in which case, the form will flicker once but remain on the screen. Clicking on the "*Cancel*" virtual button (or pressing the <Tab> key until it is highlighted and pressing the <Enter> key) will cause the software to do an orderly shutdown and close, returning control to Windows. Should the program not be able to match the sample to one of those recorded in the logbook, a Windows message box will appear informing the user and asking if the use wishes to search again. (Appendix F, image e). If the user clicks on the button marked "*Yes*" the program will return to the Sample Information Input Window where the user may click on the "*View Logbook*" button to call the default text editor (usually MS NotePad®), passing it the path and file name of the electronic logbook so it may be opened and examined for inconsistencies between the information on the box and recorded in the logbook. Closing the text editor will return the user to Capther4 and the Sample Information Form. The logbook file is normally not saved from the text editor, since text editors don't use non-conflicting sequential access and therefore provide no protection from overwriting modifications saved by others while the user was viewing the file. If edits to the logbook file are necessary, it should be opened with HerBase for editing (since it will not overwrite changes made by others working on separate workstations in other locations).

The Sample Processed or Comment Present Warning Form

If the sample is matched to one recorded in the logbook file and it is marked as already processed or there is a comment or instructions, a form is displayed containing with a message to that effect (Appendix F, image f). This form will display the sample number of the data line matched to the entered data, the number of fish recorded as having been saved, the number already done (blank if none previously processed) and the comments, if any. The data displayed may be edited before leaving the form and the new values (number of fish processed or commets) will be used if processing continues and saved at sample's end. Two virtual buttons, one labeled "*CONTINUE Processing Sample*" and "*DO NOT CONTINUE Processing Sample*" are located at the bottom of the form. After reviewing the information printed on the form, the user can continue (as in the case of a large sample split between two boxes or in the case of a sample with a comment or instructions for the lab) or abort using the appropriate button. If the user decides to process additional fish, the actual processing will begin, starting with the next fish number (one more than the number already done as read from the form on exit). If the "*DO NOT CONTINUE Processing Sample*" button is clicked, the form will be replaced by another small form asking if the user wishes to search again (Appendix F, image g). A positive answer will bring back the Sample Information Form, and a negative one will cause an orderly shutdown and exit to Windows.

If the sample is matched to one recorded in the logbook file and there are no fish recorded as done, there are no processing comments or instructions (or if the user accepts to process a sample under the conditions above) a message box is displayed warning to check that the balance and FMB-IV are indeed turned on (Appendix F, image h). This is necessary since polling of the peripheral devices will begin and if the FMB IV in particular s is not turned on or plugged in, the program will freeze. After

checking the input devices, the user need only press <Enter>.

The Capther4 Processing Window

The Processing Window then becomes active (Appendix F, image i). On the top of the screen, the software notes that it is "*Now Processing*", to indicate the program is awaiting input of biological fish data via the input devices. Fishing area, sample number, date, sampler's name, sampler's number, port and backup file path and name are displayed at the top of the screen. The program is now in a data-gathering loop consisting of 4 steps. From this point on, until all the fish are processed, all input will be via the FMB-IV and the balance.

1. The fish number is displayed and the user is prompted to measure the length of a fish or enter a comment via the measuring board. The user places the fish upon the FMB-IV, snout against the headboard, slightly above the stenciled measuring line, the tail is pinched and a magnetic probe is placed on the board surface so that it is over the stenciled measuring line and it's centering line is aligned with the end of the fish's tail. The length is measured by the FMB-IV, transmitted to the computer, is displayed on the monitor, and the user is prompted to enter the fish weight. Instead of a fish length, the user may enter a line of comment via the FMB IV. The comment's first three characters must be "**R**" "**E**" "**M**" (which will not be written to the buffer or file) and the comment proper. As the user trips each sensor, the message is displayed in the FMB IV display. Words may be separated by spaces using the sensor stenciled "f", since the initialization file for HrSchool is usually modified so that this otherwise unused sensor becomes a space key. Activating the "**Save Data**" sensor will send the message to the host which will not display the comment but store it until the sample is finished, and will appear in the dialog box displayed at the end of the sample. It will be appended to any message read in from the electronic logbook file at startup and may be edited in the dialogue box before closing. After the comment is stored, the computer continues to await the next fish length.

2. After the length is entered, the balance is zeroed, the fish is placed on it and, once stability is achieved, the weight is transmitted to the computer by pressing the balance's "print" key. The length and round weights are checked against the first group of error-checking parameters. If the data do not pass, a brightly colored warning explaining the error is displayed on the computer monitor, a verbal error message is played, and the user is prompted to measure the fish once again. The user is also informed that, to accept the data as is, "**O**" "**K**" must be entered (This is done via the alphabetic sensor array on the FMB-IV). In order to transmit the "**O**" "**K**", the user must also trigger a "**Save Data**" - or "**Newrec**" on boards with older versions of the face legend. If data are re-entered, the error-checking will be done again. If the user overrides the suspect condition (by triggering "O" "K" and "**Save Data**" on the FMB-IV), or the data pass the first group of error-checks, the program will prompt the user for entry of the next data in the sequence which is sex and a maturity code.

3. If sex can be determined, this is entered via the "**Male**" or "**Female**" sensors defined on the FMB-IV. If the sex cannot be determined, the sensor defined as a lower-cased "k" is triggered. The maturity code is entered as a number from 0-8 (any other number will be rejected by the software). If required, the fish's heart is exposed and examined for infection by Ichthyophonus hoferi. If I. hoferi is detected, a lower cased "y" is triggered on the FMB-IV, followed by a number between 1 and 3 (1 = low level infection, 2 = medium level infection, 3 = high level infection). A "**Save Data**" ("**Newrec**" on boards with older versions of the face legend) is triggered to send this data from the FMB-IV to the computer. At this point, the user may also

doubt the length and weight data even though it passed the error-checking routines. If this be the case, the user may return to the point where length and round weight may be re-entered by keying in "**R**" "**E**" "**D**" "**O**" on the FMB IV's alphabetic sensor pad and triggering a "**Save Data**" (**Newrec** on older boards).

4. The user is then prompted to enter the gonad weight. Once the balance is zeroed, the gonads are placed on it, and, after stabilization, the balance's "print" key is pressed to send the weight to the computer. Immediately upon receiving the data, the computer calculates a gonadosomatic weight ratio and compares this to that obtained for fish of similar size and maturity stage in historical data. If data does not pass the error-checking, an audio and visual prompt is displayed and the program loops back to step 3. If the user, after inspecting the data displayed, believes that an error may have occurred, the sex, maturity stage, I. hoferi infestation rate and gonad weight may be re-entered. If the data are judged correct, triggering "**O**" "**K**" on the FMB IV and then a "Save Data" (**Newrec** on older boards). If the data pass the error-checking, the backup file is opened, data are written to it and it is closed, and a copy is also stored in memory for adding to the main file when the sample is completely processed.

Once the data for a fish is stored and written to the backup file, the program returns to step 1. This continues until the fish are all dissected. The program will be awaiting a length. The user enters "**E**" "**N**" "**D**" "**Save Data**" via the FMB-IV instead of a fish length to exit the fish data gathering loop.

The User Comments Entry Window and End of Sample Routine

When the program receives the "**END**" command, it immediately goes into the 'end-of-sample' routine, starting with the part that updates the principal detail biological file. A large-font message is printed on the monitor indicating that all the data accumulated during the session is being written to file. The main detail biological data file is opened, the proper location is found and the data are written to it. Samples are written to file in order by sample number.

Once all the detail biological data are written to file, a dialog box is printed over the window (Appendix F, image J), asking for user comments and displaying the number of fish done. Any comments entered via the FMB IV during processing will be displayed in the comments edit box, appended to any prior comments if any. Further comments about sample particularities or problems during sampling may be entered at this time. There is a limit of 85 characters allowed for Processor comments because of limitations in the archival ASCII format files. When the user clicks on the "*OK*" virtual button or presses the <Enter> key, the computer displays a message stating that the electronic logbook is being updated as log data are written. Besides user comments and number of fish done, the date of processing will also be added to the sample's electronic log entry. The software then updates the defaults part of the initializations file. These paths and filenames will become the defaults for the next session. Capther4 then terminates, returning control to Windows.

FMBoardApps

The Limnoterra FMB IV electronic fish measuring board is a rugged, waterproof data gathering device that is accurate, efficient, and may be modified to suit the needs of the user. To do that, it runs a complex operating system using sensor and macro definitions loaded into memory using a series of

commands and tokens. Programmed in assembly and designed during the glory days of MS-DOS®, the original software written to program, test and use the instrument was difficult for the average user to learn to use. This software is not supported properly under modern graphic user interface based operating systems. FMBoardApps has facilities to permit the user to accomplish these tasks in the Windows 98 SE® and XP® environment.

The FMBoardApps opens to a main window that has a three-item main menu (Appendix G, image a):

- "*Choose Activity*"
- "*Help*"
- "*About FMBoardApps*".

Choosing the Third menu item, "*About FMBoardApps*", will cause the display of a window containing information about the program's origins and version (Appendix G, image b).

The second menu item, "*Help*", starts a WinHelp session opening at a table of contents.

The first menu item, "*Choose Activity*" when chosen, opens to a 6 item submenu item list. The first five will each call specific routines that will interact with the FMB IV (Appendix G, image a). The last causes an orderly exit from the program. The menu items are:

- Set Baud Rate
- Send Something to FMB
- Initialize FMB Sensor Definitions
- Destructive Poll of FMB
- Download Data in FMB to File
- Exit

Resetting The FMB IV's Communications Port

The first option, labeled "*Set Baud Rate*" (which replaces Limnoterra's MS-DOS program "Setbaud.com") resets the FMB IV's communications port to defaults. It does this by sending a sustained break signal to the FMB. This can sometimes be enough to "kick start" an FMB who's internal program has somehow crashed the port. This should cause a software reset of the port in the FMB, if the rest of the FMB's programming is still working well enough to respond. When chosen, there will first be a display of a small message box warning the user to turn on the FMB IV before proceeding (Appendix G, image c). An audio prompt will also play. Clicking on the button will cause the program to continue. At this point, the top edit box in the main window reads: "*Resetting the FMB. Please wait for Message to Clear.*". If no message is printed in the bottom box, the operation was a failure. If the routine is successful, an alpha-numeric serial number (ex. "*AF4139H*") is printed in the response box for a short while (Appendix G, image d). The display of the FMB IV also displays "O.K.".

Sending Commands to the FMB IV

Selecting the second item on the drop-down menu, "*Send Something to FMB*" will allow the user to send simple commands to the FMB IV and to monitor the board's response to them. Several are listed on the pop-up window that appears right after the selection is made, along with expected responses (Appendix G, image e).

The "MZ" and "MP" commands listed are special commands that place zero all active memory locations. The first also forces a software re-boot of the system. "MP" does not. All data stored in the FMB IV will be irretrievably lost after these commands are sent. However, in more severe software crashes, some erroneous program lines may remain after less powerful commands are sent, but may be erased by these procedures. Once the entire memory has been cleared with the "MZ"or "MP" command, the user must re-initialize the FMB by sending it its sensor definitions again using the "*Initialize FMB Sensor Definitions*" menu option. Some other useful commands are not listed on the form but may be found in the FMBoardApps WinHelp.

Initializing the FMB IV

The third menu item, "*Initialize FMB Sensor Definitions*" will re-program the FMB IV with what macros to run when specific sensors are activated. The definitions file used to initialize must be correct for the type of FMB IV, the legend permanently stenciled under its clear Lexan® surface, and the intended use. This may be chosen via the form which pops up after this option is chosen from the main menu (Appendix G, image f).

Limnoterra FMB IVs are usually shipped with standard versions of definitions file for the .25 cm and the 1mm resolution boards. These are intended for use when the FMB is downloaded after all fish in a sample have been processed, storing all data in RAM memory while awaiting download. HrSchool software are meant to download data as it is entered into the FMB IV. As a consequence, they require a modified version of the definitions file so lengths will be immediately forwarded to the FMB IV memory and then to the polling host. Two legend versions are still in use for the .25 resolution boards. Each of those requires a specific file so sensors will match the stenciling. The HrSchool definitions file also changes the definition of one sensor (the lower-cased "f" sensor) to a "space" character for use when typing comments via the FMB. Therefore, six ".def" files are normally be supplied with FMBoardApps to accommodate the different combinations of legend, resolution and use. These are saved to the "HrSchool/FMBoard/FMBIV" folder.

A useful debugging feature of the FMBoardApps function is that it writes exactly what is being sent to the FMB IV and its response in a file called "CommandFile.txt". This file is located in the "HrSchool/FMBoard" directory. This file may be viewed using a Hex Editor (necessary since many commands such as macro numbers are numerical in nature). This file may be forwarded via removable computer disk (floppy, CD, DVD) or electronic mail to a knowledgeable technician for interpretation if the user is unable to understand it. If it runs successfully, the file should begin with the following ASCII lines which may be viewed with any ASCII text viewer:

Last definitions file used:
C:\HrSchool\FMBoard\Fmbiv\nfhrschl.def
Sustained Break Sent
*Command = *AMP Response = A*
Sustained Break Sent

.
. (18 lines of ASCII commands and FMB IV responses)
.

*Command = *AXFS000024####N##o##i## ##D##e##f##i##n##e##d# ..... Response = A*

.
. (Many similar lines beginning with "AX" and containing a number of numeric command elements)

*Command = *AB ..... Response = A*
*Command = *ATNewFace Hrschool ..... Response = A*

After these two last commands, the FMB IV should beep and one of the following text messages "NewFace Standard", "NewFace Hrschool", "OldFace Hrschool", "OldFace Standard", "HrSchool1mm Loaded", or "HrSchool Loaded", should appear on its display as the routine successfully ends.

Destructive Poll Of The FMB IV

The fourth option in the menu is a Destructive Poll of FMB IV. When using this option, the FMB is continuously polled destructively (using the "H?D" command) and the data received is simply displayed on the screen (Appendix G, image g). This is useful when out an FMB IV that just has been initialized to be sure sensors respond correctly. By using the destructive poll function, the user need not worry about erroneous data staying in the FMB IV's memory after the exercise. If everything is working as it should, the FMB IV will be ready for use immediately after testing. Entering "**E**" "**N**" "**D**" and triggering a "**SaveData**" sensor causes the routine to end, returning to the main window.

Downloading Data Stored In The FMB IV Verbatim To A File

The fifth option in the FMBoardApps menu is "*Download Data in FMB to File*". This option may be used to download an FMB that has been used in a stand-alone operation to measure fish, etc. and contains data in its RAM. All data returned by the FMB IV (including the FMB IV's device code, usually set to "A") will be written to the file. It can also be used to download and save to file an FMB IV interactively as data are entered, providing a verbatim file of all data until the string "END" is entered into the FMB IV. No error-checking, parsing or formatting of data occurs.

When the Download Data option is chosen, a window with two edit boxes, two radio buttons and two regular buttons opens (Appendix G, image h).

The topmost edit box in this form is for entry of a path and file name to write the data to. The file will be created if it doesn't already exist or data downloaded will be appended to any present in a file already present. The lower edit box is used by the program to print out data to the screen temporarily as it is downloaded.

The topmost radio button is the default and, if checked, will permit downloading of data already stored in the FMB IVs RAM (download will stop when the FMB IV is emptied of all data.) If the user clicks on the lower radio button it then will be checked, and the download will be "interactive", expecting data to be entered as it is downloaded (entering "**E**" "**N**" "**D**" and trigger a "**SaveData**" sensor on the FMB IV to stop download).

When the leftmost button is clicked (or the <Enter> key is pressed) the program will continue, first displaying a windows message box (and playing an audio prompt) warning to ensure that the FMB IV is turned on.

When the OK button is clicked (or the <Enter> key pressed), the program opens the specified file for append and the COM port and begin the download. Any data already in the file will not be overwritten but new data will be added after any existing.

The last choice on the drop-down menu is "*Exit*". This will perform an orderly shutdown of the entire FMBoardApps program and return control to the calling program (the HrSchool software from which FMBoardApps was called or Windows® if it was called using a desk-top icon).

Process

When called (from Capther4 or directly from Windows via a shortcut), the Process utility opens with a small form containing four Windows Edit Boxes and a virtual button (Appendix F, image m):

- "*File To Search*" permits entry of the complete path and filename of the herring logbook file
- "*Month*" month to search (entry must be numerical and the program at this time only searches within one month)
- "*Start Day*" first day of the month to use
- "*End Day*" last day of the month to include
- "*Search*" (virtual button) causes the program to search the logbook, calculate the number of fish processed and remaining, call the default text editor (usually NotePad®) and request user confirmation to launch it. Upon being prompted to do so, the text editor is opened, with the results of the search having been passed to it and being displayed.

If any fish were processed during this time period, the output from Process will be displayed in the following order:

Time period studied

- One or several line pairs consisting of:
  - sample number of sample processed, port (or survey number),Month sampled, NAFO area
  - Day processed, month processed, number of fish processed

- Time period studied

- Total number of fish processed during this time period

- Total number of spring-caught fish saved
- Total number of spring-caught fish processed
- Number of spring-caught fish not yet processed
- Number of spring fish aged

- Total number of fall-caught fish saved
- Total number of fall-caught fish processed
- Number of fall-caught fish not yet processed
- Number of fall fish aged

- Total number of autumn inshore (gill net) commercial fish saved
- Total number of autumn inshore (gill net) commercial fish processed
- Total number of autumn inshore (gill net) commercial fish aged

- Total number of autumn Mesh Selection Project fish saved

- Total number of autumn Mesh Selection Project fish processed
- Total number of autumn Mesh Selection Project fish aged

- Total number of autumn Purse Seine fishery fish saved
- Total number of autumn Purse Seine fishery fish processed
- Total number of autumn Purse Seine fishery fish aged

- Total number of yearly Herring Acoustics Survey fish saved
- Total number of yearly Herring Acoustics Survey fish processed
- Total number of yearly Herring Acoustics Survey fish aged

- Total number of yearly Groundfish Trawl Survey fish saved
- Total number of yearly Groundfish Trawl Survey fish processed
- Total number of yearly Groundfish Trawl Survey fish aged

Closing the text editor will return the user to the Process secondary window. Closing it in turn will return to the calling program (Capther4 or Windows).

GetNewLimits

The GetNewLimits facility is used to update the maximum and minimum check values Capther4 uses to assess fish data as it is entered. These are stored in the "Capther4.ini" file along with defaults to be used for the upcoming sessions. After making a backup copy of the existing file for security purposes, the facility may be run to prevent nuisance warnings if variations in growing conditions have caused fish data to be too often falsely identified as possibly erroneous. Alternatively, if the user believes the variation allowed is too great, the facility may be used to produce a more stringent checking of data.

When called from the Capther4 main menu, the GetNewLimits utility opens with a form containing seven Windows Edit Boxes and a virtual button (Appendix F, image k):

The first Windows Edit Box, labeled "*Herring data File Directory*" should contain the path to the Windows folder containing the detail biological data files.

The second Windows Edit Box, labeled "*Password Required to Run Program*" is for entry of the default password (to prevent accidentally overwriting the check-values file with less appropriate values than the current ones). This password is hard-wired in the program, cannot be changed, and may be found in the help files by using the "Find" function and searching for "password".

The third Windows Edit Box is labeled "*Oldest Data Year To Use*". The year entered here will be the oldest one used to calculate the new parameters.

The forth Windows Edit Box is labeled "*Newest Data Year To Use*" and will be the most resent data used for the calculations.

Labeled "*Max Number Of Observations (N) Per Group*", the fifth Windows Edit Box permits the user to specify the maximum "n" for calculations. The number of observations will be all fish that meet the length-group criteria up to this maximum. It defaults to 250 observations.

The sixth Windows Edit Box, labeled "*Multiplier for Confidence Interval*" defaults to 2.43. This number will be used as a multiplier along with the standard deviation of the sample calculated from the data gathered from the archival database as specified calculated using the standard C++ standard deviation function. The default value for this multiplier is 2.43 (which should give limits accepting 98% of the sample data). If there is a lot of variability compared to historical data, too many fish will be flagged by the routines. In this case, the multiplier may be changed to a larger value so more data variance is accepted and, hopefully, only 2 - 4 % of fish get flagged by the software. This will prevent user fatigue and the possibility of bad data inadvertently being accepted by a conditioned user and entering the database.

In the Windows Edit Box labeled "*Directory and Filename of Limits File*" is the default path and filename of the Capther4 initialization file. This should normally not be changed.

Clicking on the virtual button marked "*CreateFile*" will cause the program to calculate new error-checking upper and lower values for each parameter per length group, and then write them in the proper place and in the proper format to the Capther4.ini file. Capther4 may then continue on to process fish and these new values will be used to check the incoming data.

USER DOCUMENTATION

The HrSchool software suite is documentation for all software is provided via the WinHelp® help system incorporated with the 32-bit Windows® platform. The actual names of the HrSchool help files are:

- HRSCHOOL.HLP
- HERBASE.HLP
- CSURVEY.HLP
- CSURVEY132.HLP
- CSURVEY232.HLP
- CAPTHER4.HLP
- FMBOARDAPPS.HLP

As with all WinHelp files, the HrSchool documentation files may be run directly by double-clicking on their icon in the Windows Explorer. There are, however, links to the appropriate files via menu items in each program. These files are meant to replace a hard-copy "user's manual" and contain full documentation of the software, including step by step user instructions, file locations and formats as well as troubleshooting guides. The WinHelp files also contain images of various screens for each program, include many hotlinks permitting direct jumps to related subjects, and have comprehensive search and index facilities, so they make it easy to find particular information which may be needed.

As with all WinHelp files, the HrSchool documentation files may be printed in whole or part if

desired, but also run independently on the Windows platform permitting the user to also work with the software, switching between the two as needed.

The HrSchool WinHelp files are normally copied with the software during installation, the user is virtually guaranteed to have a copy of the relevant documentation if and when needed.

RESULTS

Use of an automated data gathering system for collecting fish data are efficient for compiling and recording standard length frequency information (Table 1.) and for gathering detail biological data (Bourque and Cairns, 1994). With incorporating real-time error checking, it can produce data of exceptional accuracy, with few "outliers" (Appendix H, plates a) and b)), which require time for identification and manual removal - a process that can introduce new errors due to the sample not normally being available to be re-measured. Therefore, in traditional systems, unusual but correct data may be removed or errors that are near to normal values may be left in the files but because automated systems validate data as it is being gathered, the specimen is still available and may be re-measured if data are suspect. In these systems, good data that is outside test parameters may be accepted and written to file and erroneous data may be easily corrected before entering the data stream.

Table 1.
Number of fish measured, total time required to measure and record lengths while concurrently saving a length-stratified sub-sample, and average number done per minute for 15 samples using the CSurvey automated fish measuring facility.

Number of fish Measured	***Time required in Minutes***	***Fish measured Per Minute***
231	19	12.16
181	15	12.07
171	23	7.43
257	19	13.53
233	20	11.65
251	23	10.90
279	19	14.68
299	21	14.24
230	17	13.53

Number of fish Measured	*Time required in Minutes*	*Fish measured Per Minute*
240	17	14.12
203	16	12.69
227	18	12.61
181	15	12.07
188	15	12.53
229	18	12.7
All Sets: 3400	275	12.36

ACKNOWLEDGEMENTS

The authors thank Jim Keen of Limnoterra Ltd. for insights into the FMB IV electronic fish measuring board and electronic fish measurement. We also wish to thank Elmer Wade and Daniel Caissie for their critical review and many helpful comments about this document.

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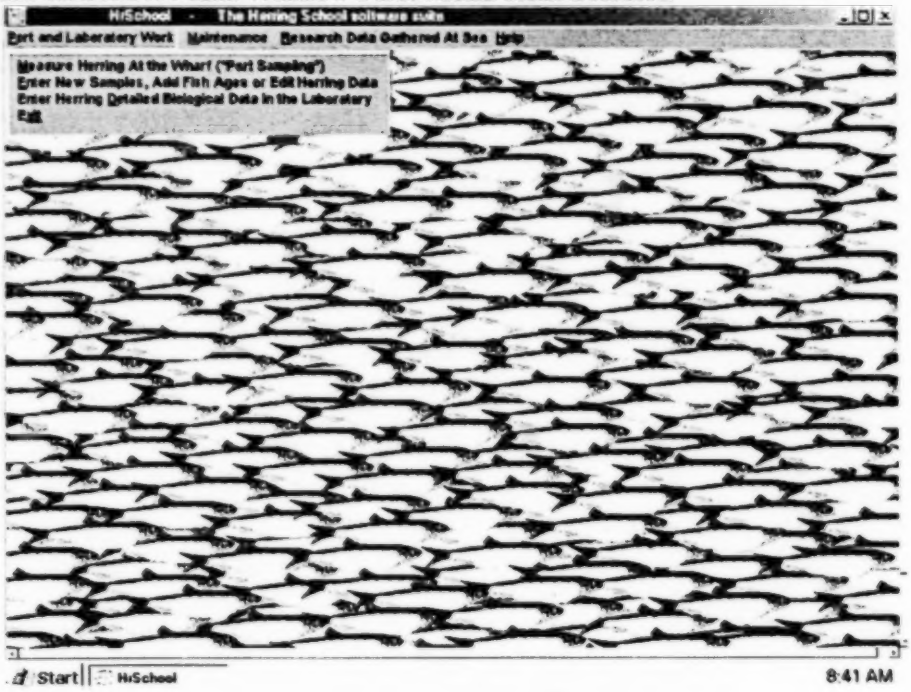
Newton, A. W., 1984. A semi-automatic measuring board (for recording fish lengths). Scottish Fisheries Bulletin 48:54-55.

Rubec, P. J. and R. J. Planck, 1984. The development of a portable fish measuring station for electronic data acquisition in the field. Northwest Atlantic Fisheries Organization, Scientific Council Research Document 104, Darthmouth Nova Scotia.

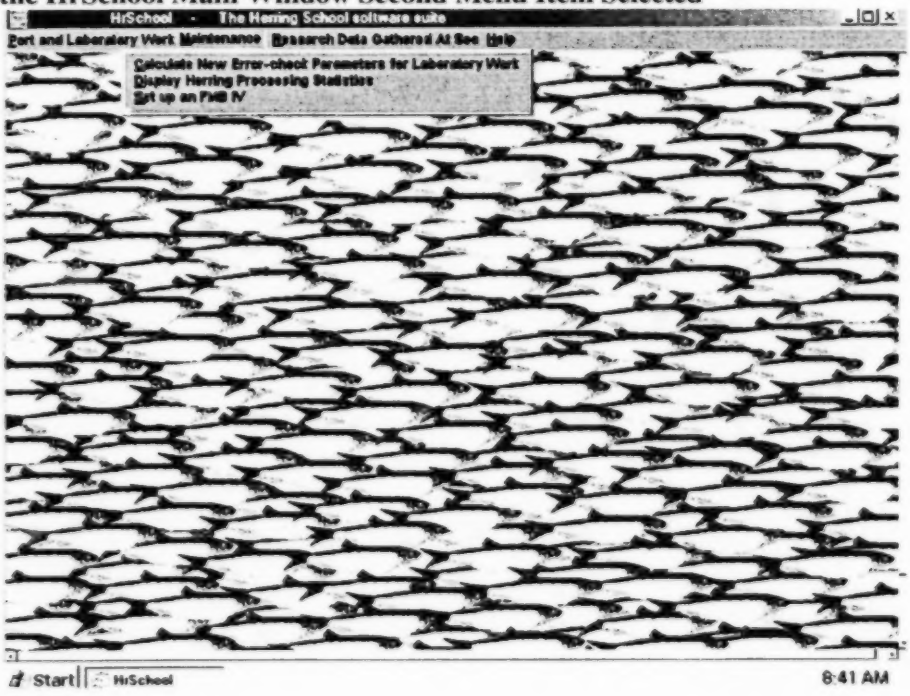
APPENDIX A

Images of the HrSchool Windows

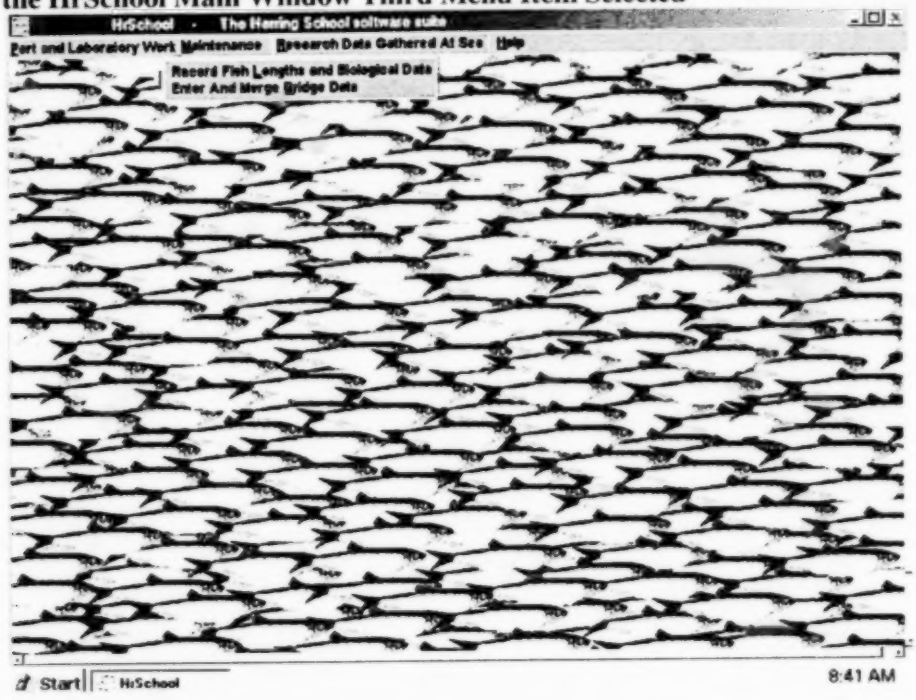
a) Image of the HrSchool Main Window First Menu Item Selected


HrSchool - The Herring School software suite
Port and Laboratory Work Maintenance Research Data Gathered At Sea Help
Measure Herring At the Wharf ("Port Sampling")
Enter New Samples, Add Fish Ages or Edit Herring Data
Enter Herring Detailed Biological Data in the Laboratory
Exit
Start
HrSchool
8:41 AM

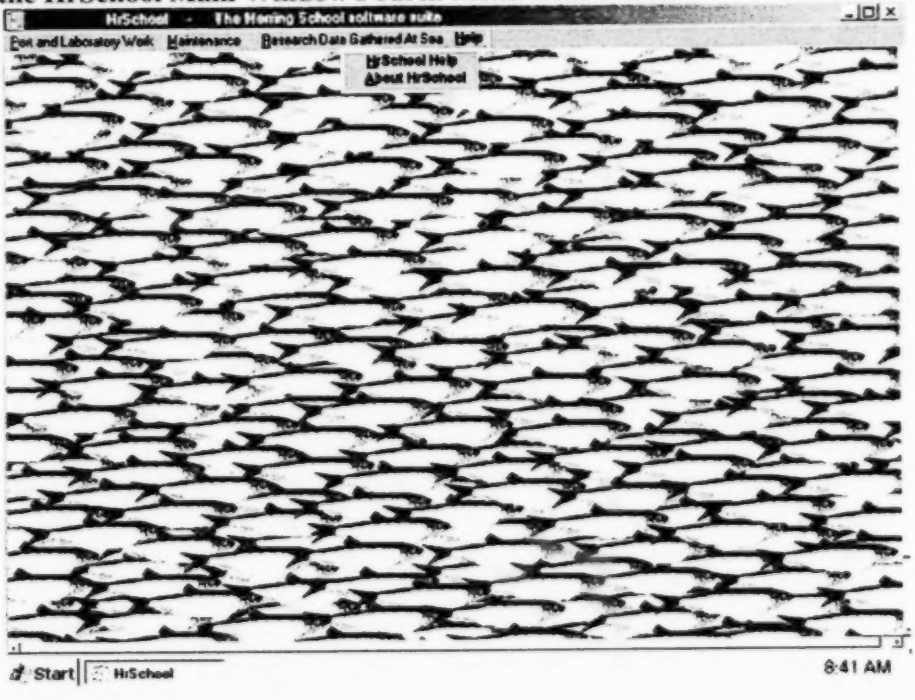
b) Image of the HrSchool Main Window Second Menu Item Selected


HrSchool - The Herring School software suite
Port and Laboratory Work Maintenance Research Data Gathered At Sea Help
Calculate New Error-check Parameters for Laboratory Work
Display Herring Processing Statistics
Set up an FMB IV
Start
HrSchool
8:41 AM

c) Image of the HrSchool Main Window Third Menu Item Selected


HrSchool - The Herring School software suite
Port and Laboratory Work Maintenance Research Data Gathered At Sea Help
Record Fish Lengths and Biological Data
Enter And Merge Bridge Data
Start
HrSchool
8:41 AM

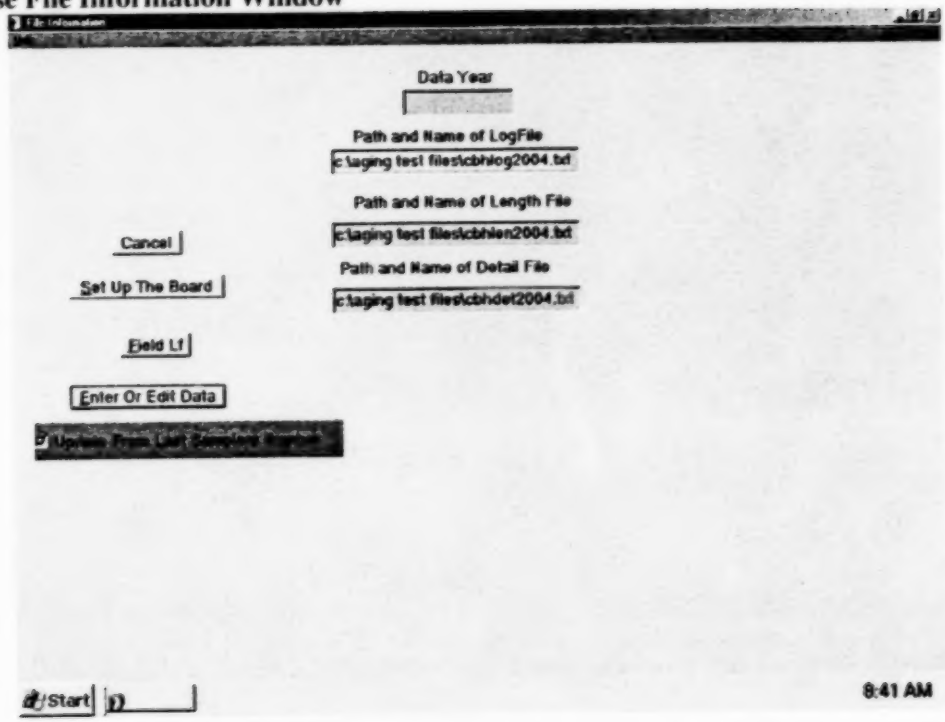
d) Image of the HrSchool Main Window Fourth Menu Item Selected



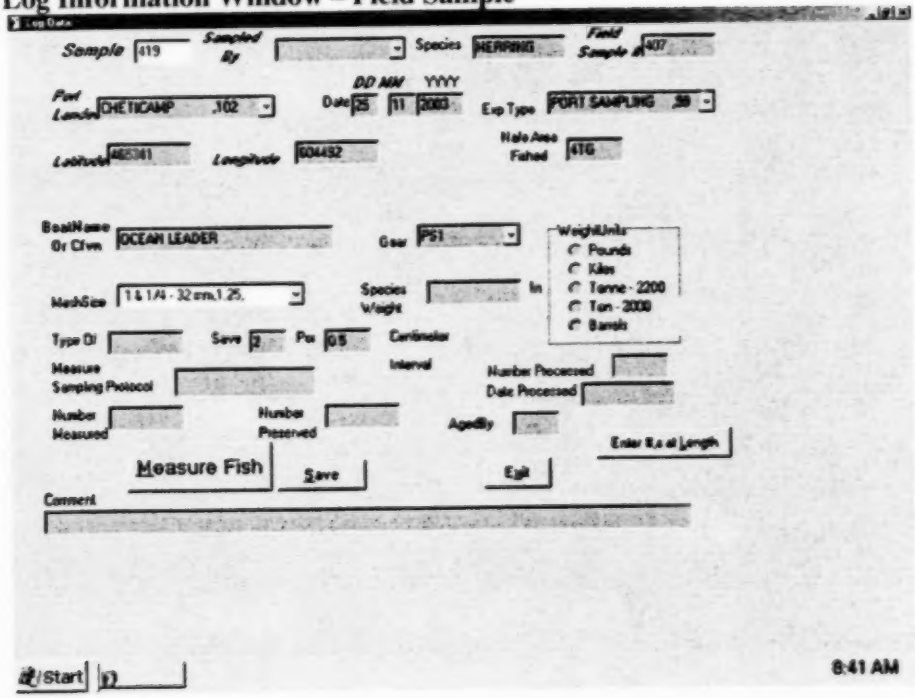
APPENDIX B

Images Of HerBase Windows

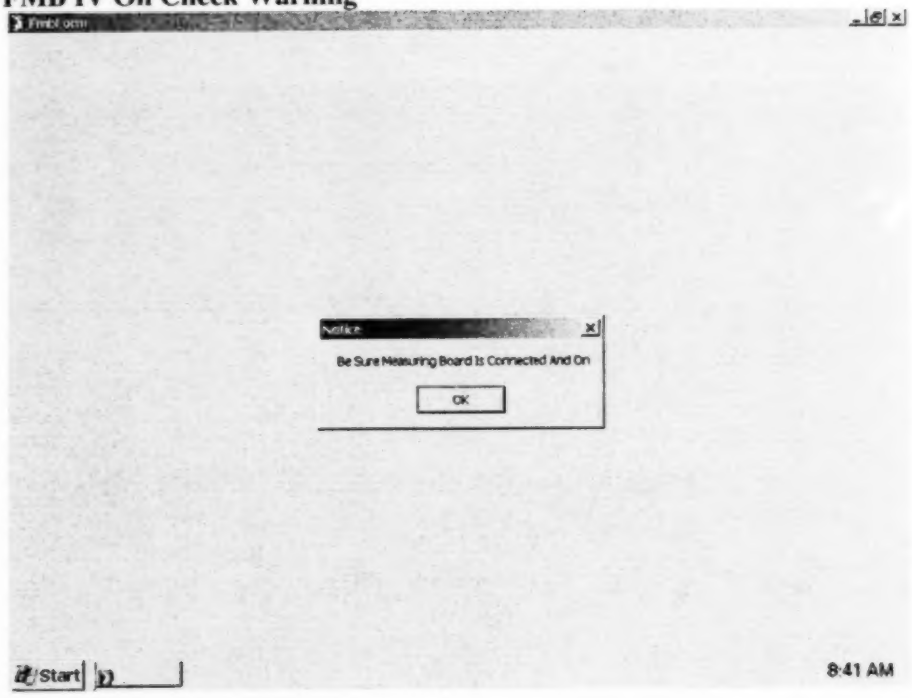
a) HerBase File Information Window



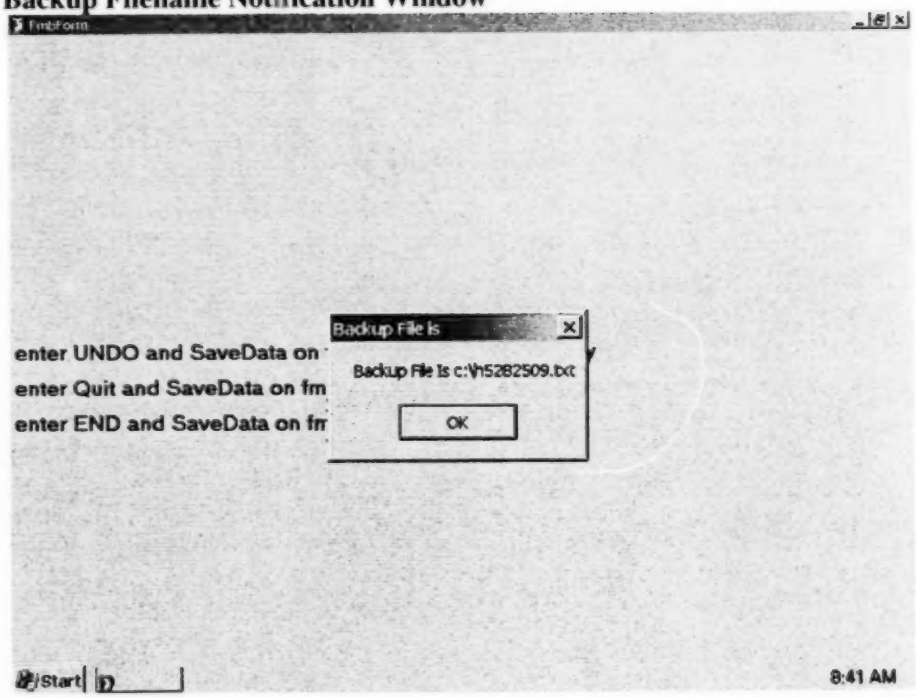
b) HerBase Log Information Window – Field Sample



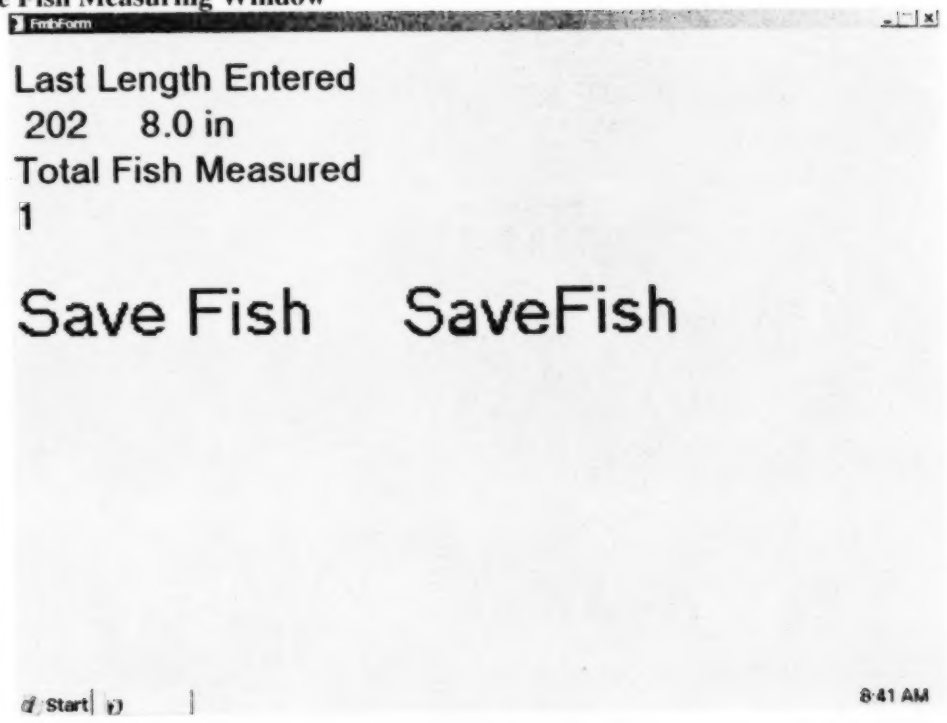
c) HerBase FMB IV On Check Warning



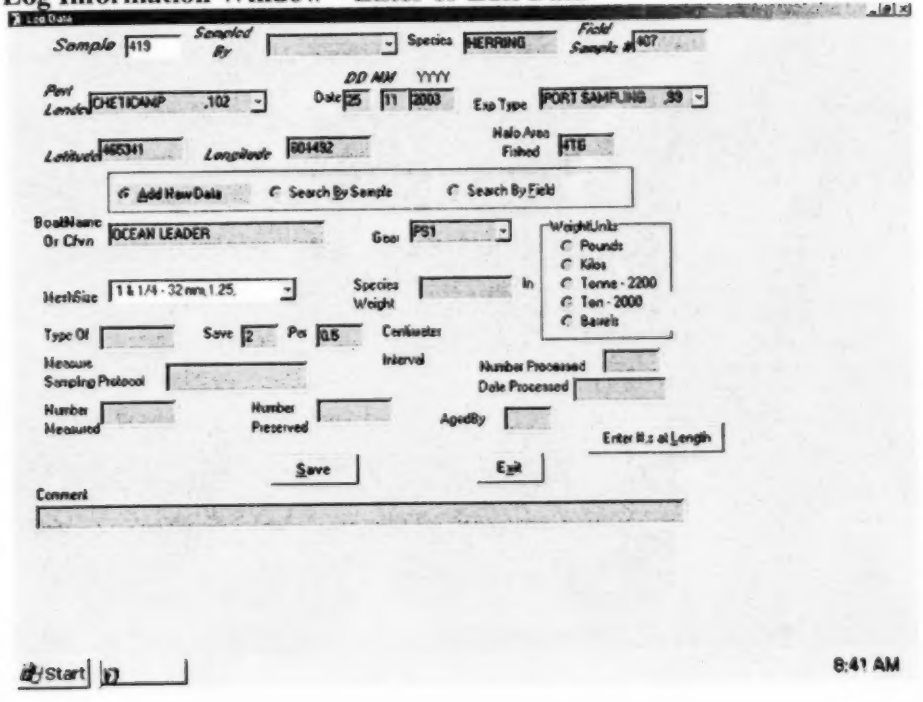
d) HerBase Backup Filename Notification Window



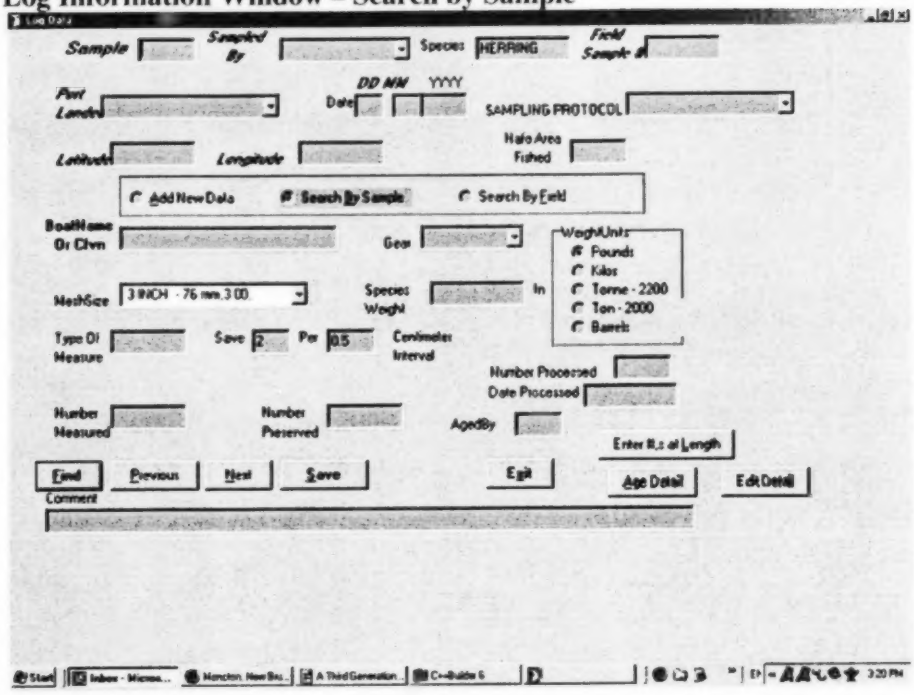
e) HerBase Fish Measuring Window



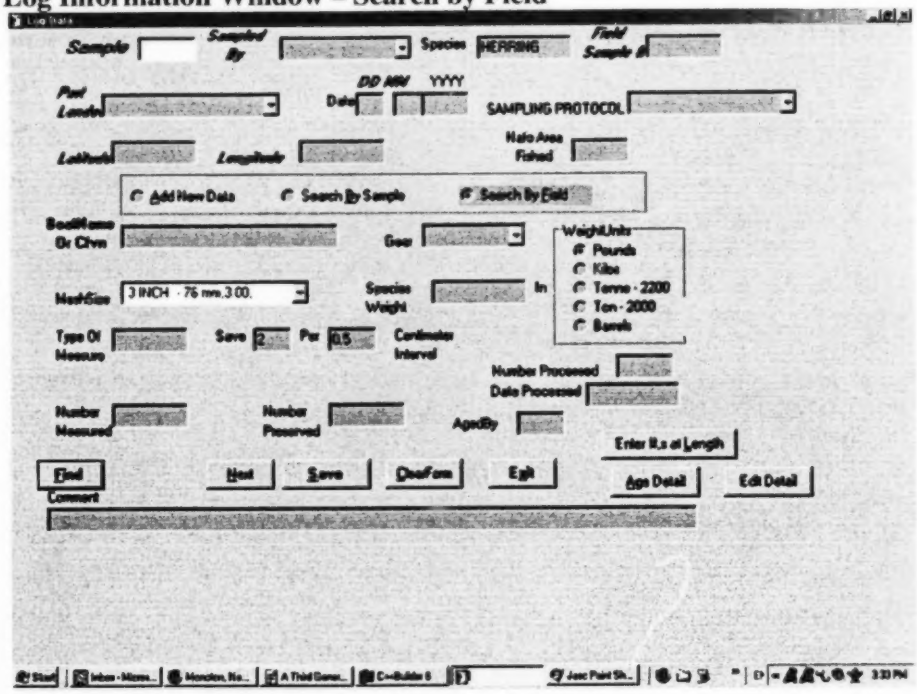
f) HerBase Log Information Window – Enter or Edit Data



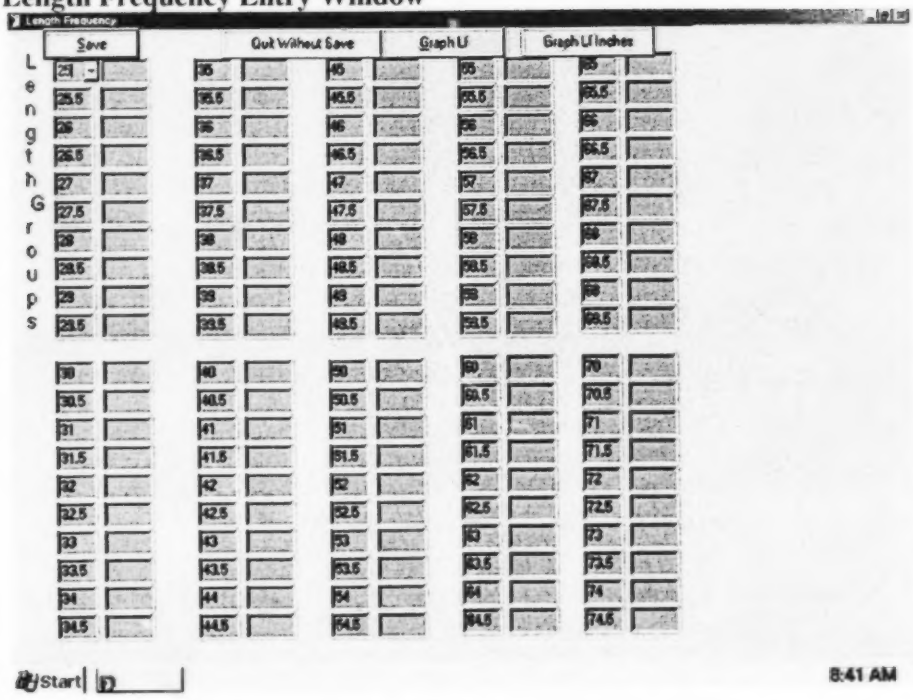
g) HerBase Log Information Window – Search by Sample



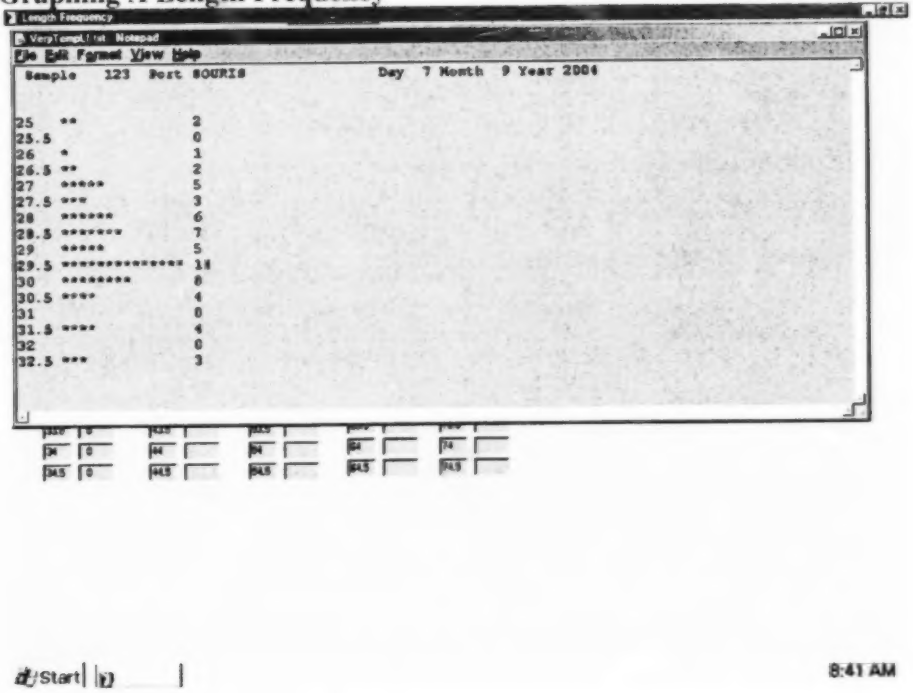
h) HerBase Log Information Window – Search by Field



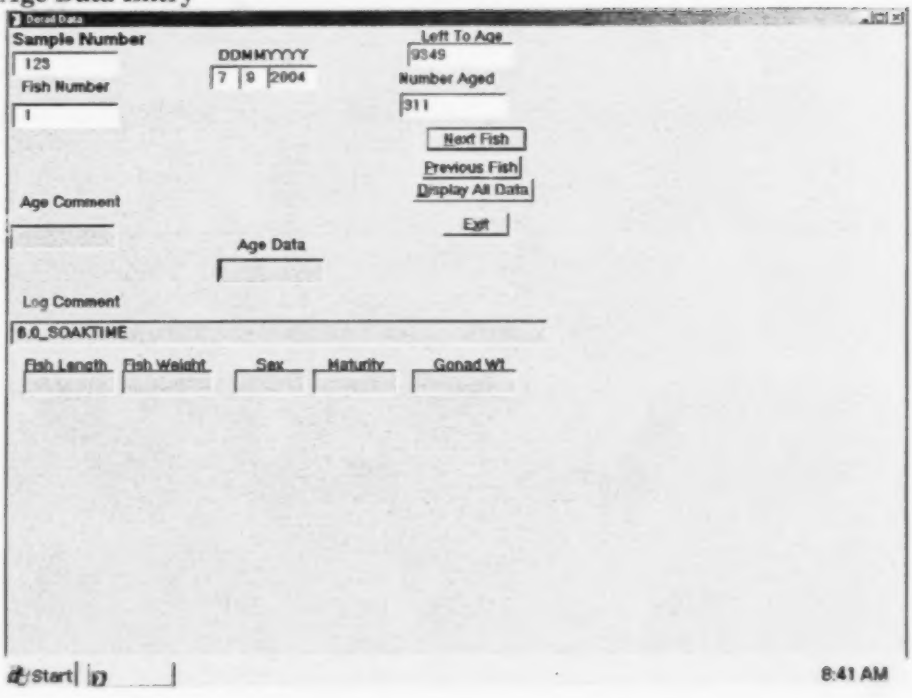
i) HerBase Length Frequency Entry Window



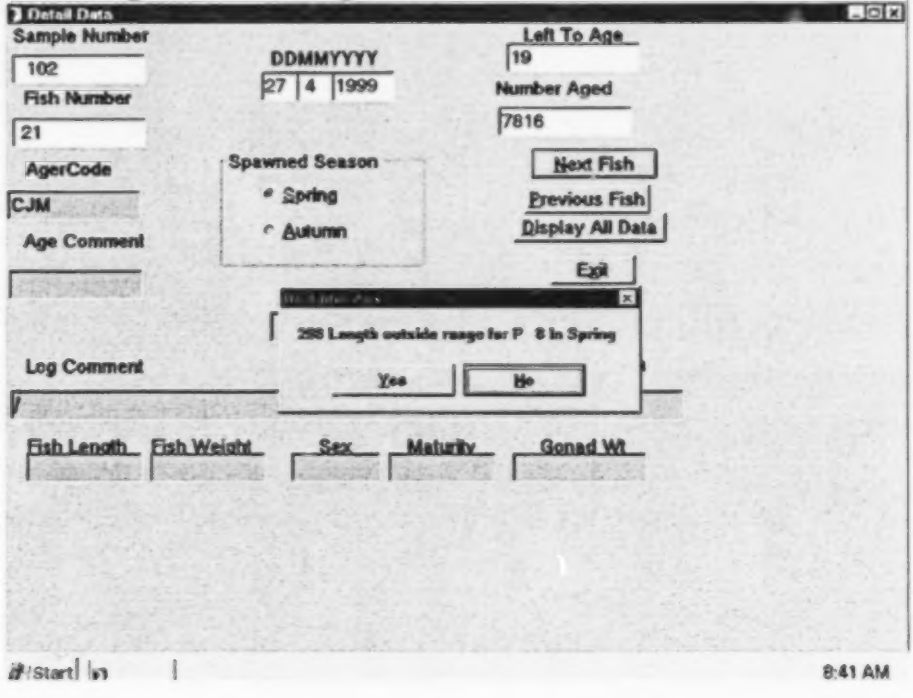
j) HerBase Graphing A Length Frequency



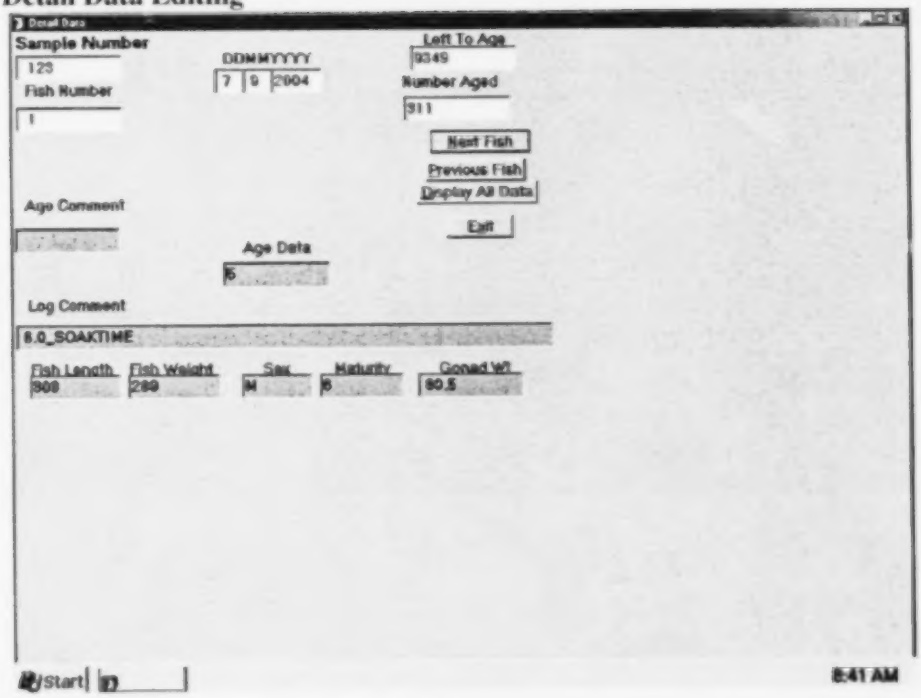
k) HerBase Age Data Entry



l) HerBase Possible Age Error Warning Screen



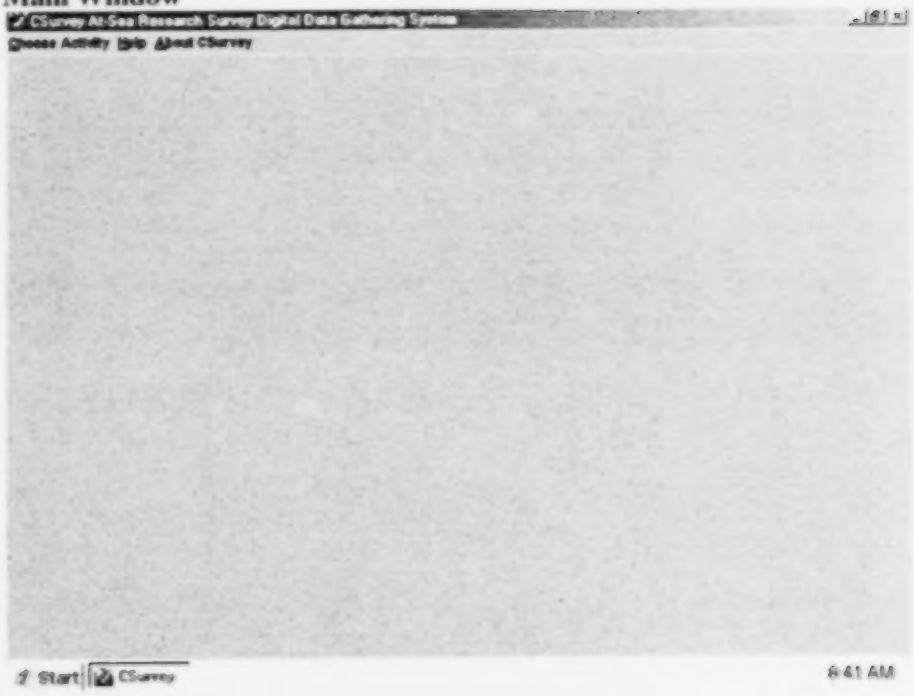
m)HerBase Detail Data Editing



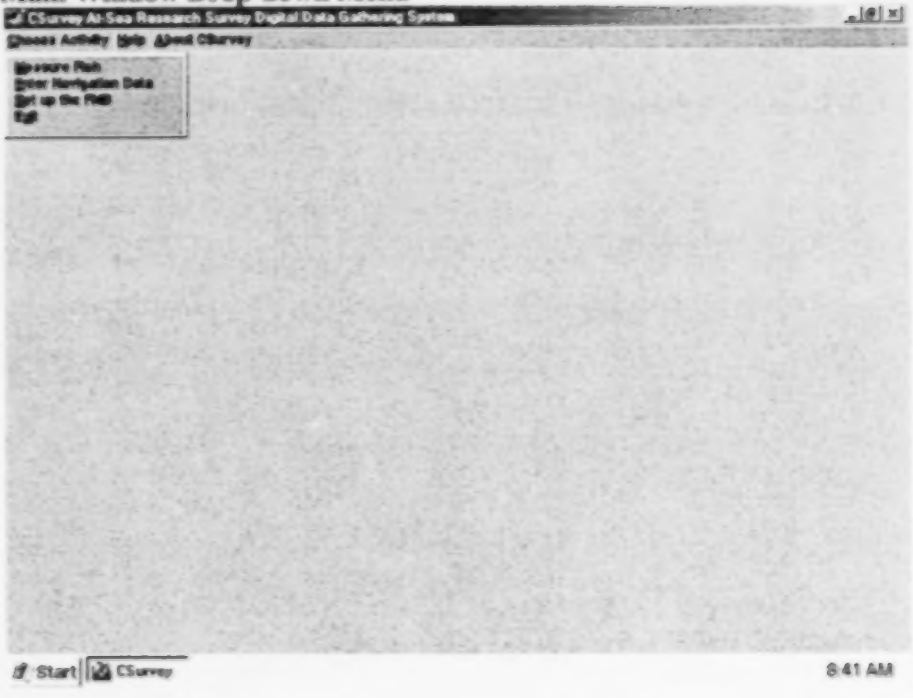
APPENDIX C

Images of CSurvey Windows

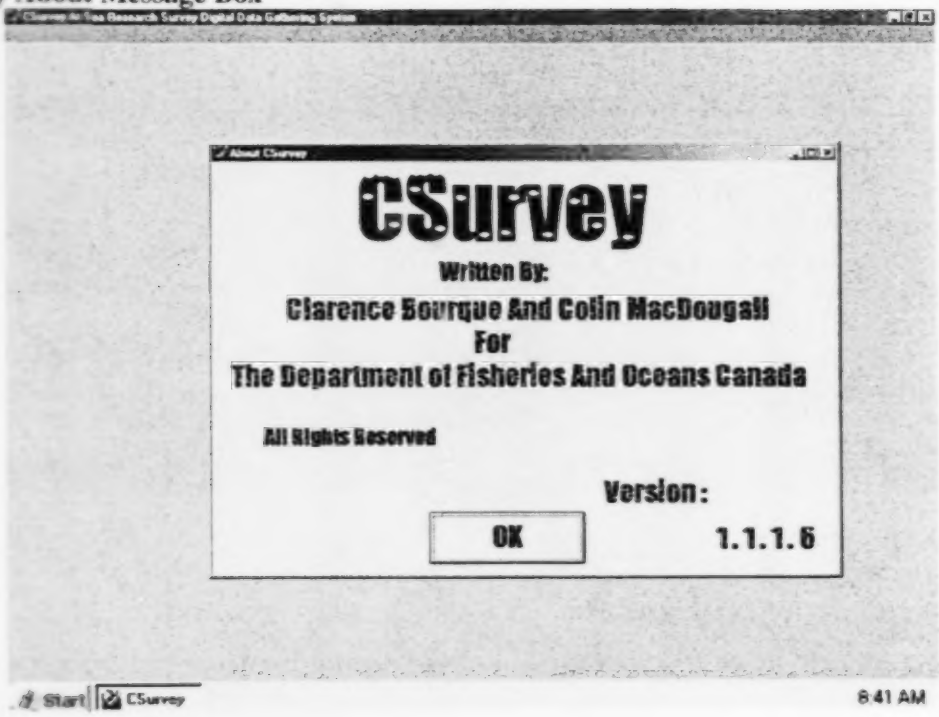
a) CSurvey Main Window



b) CSurvey Main Window Drop-down Menu



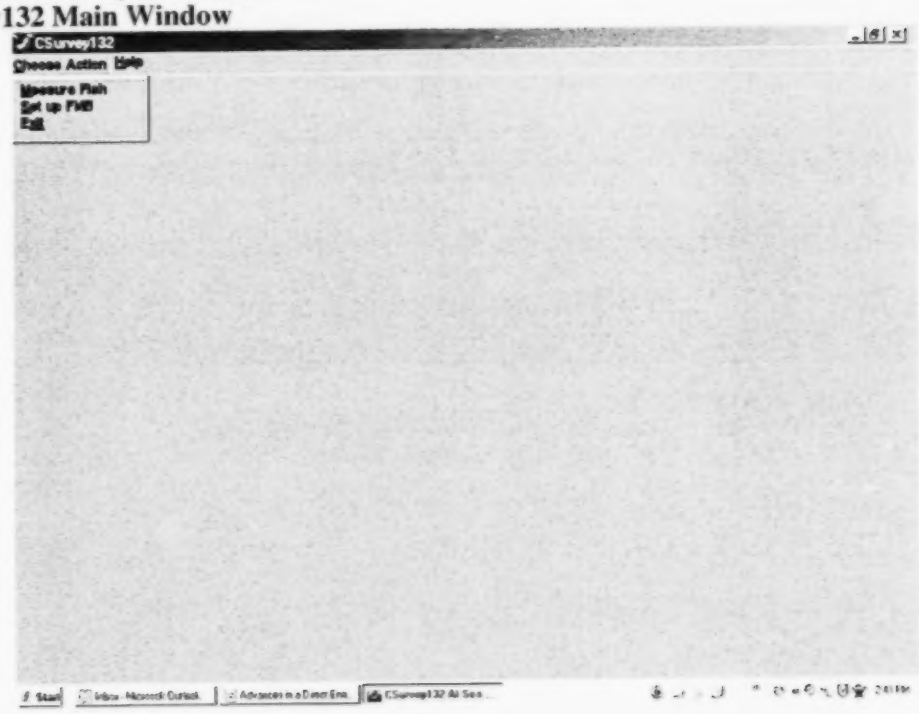
c) CSurvey About Message Box



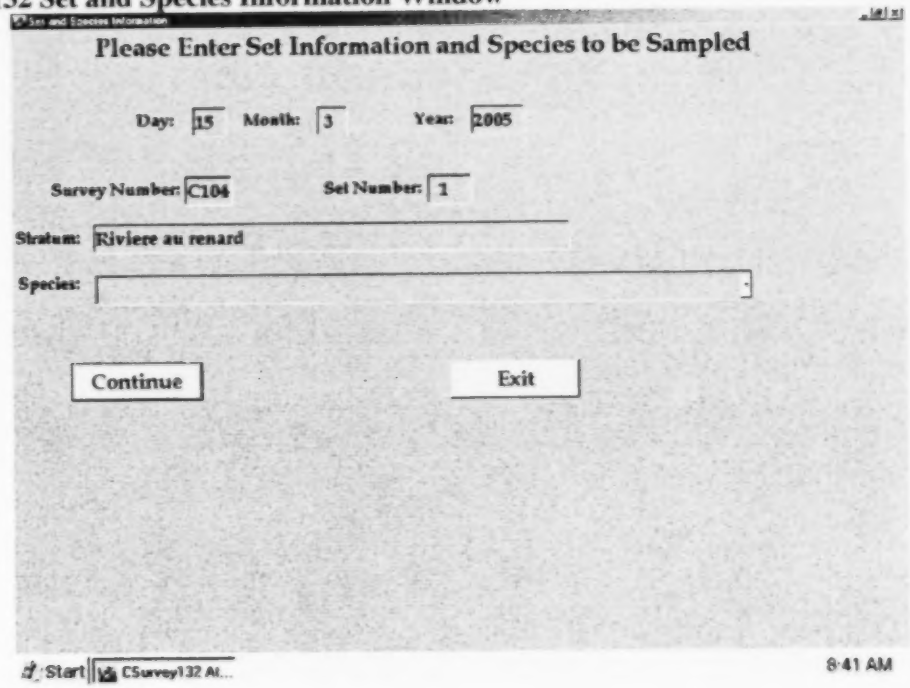
APPENDIX D

Images of CSurvey132 Windows

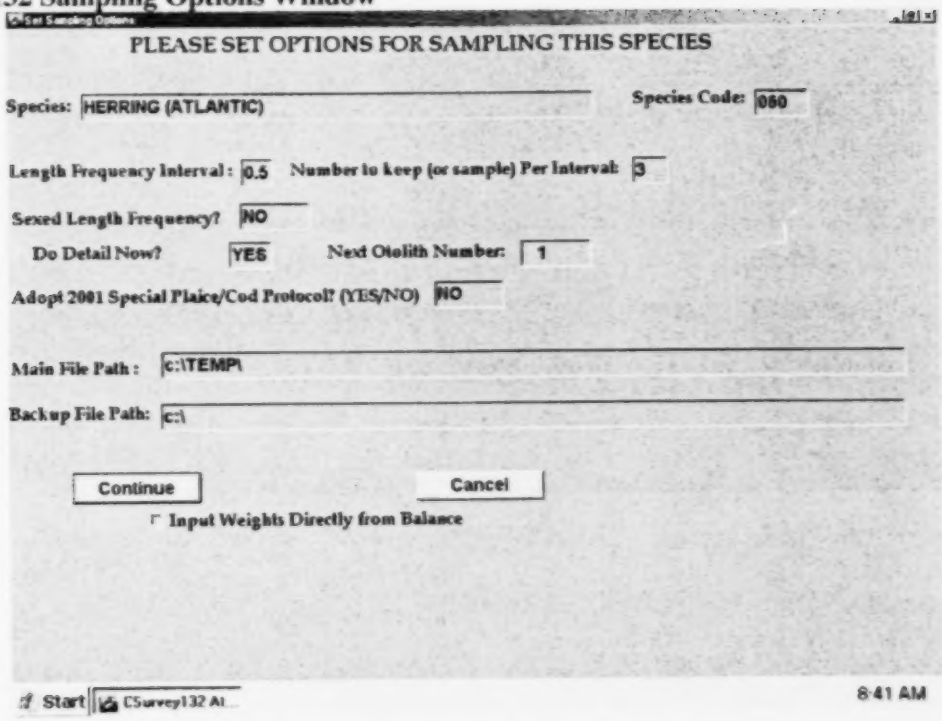
a) CSurvey132 Main Window



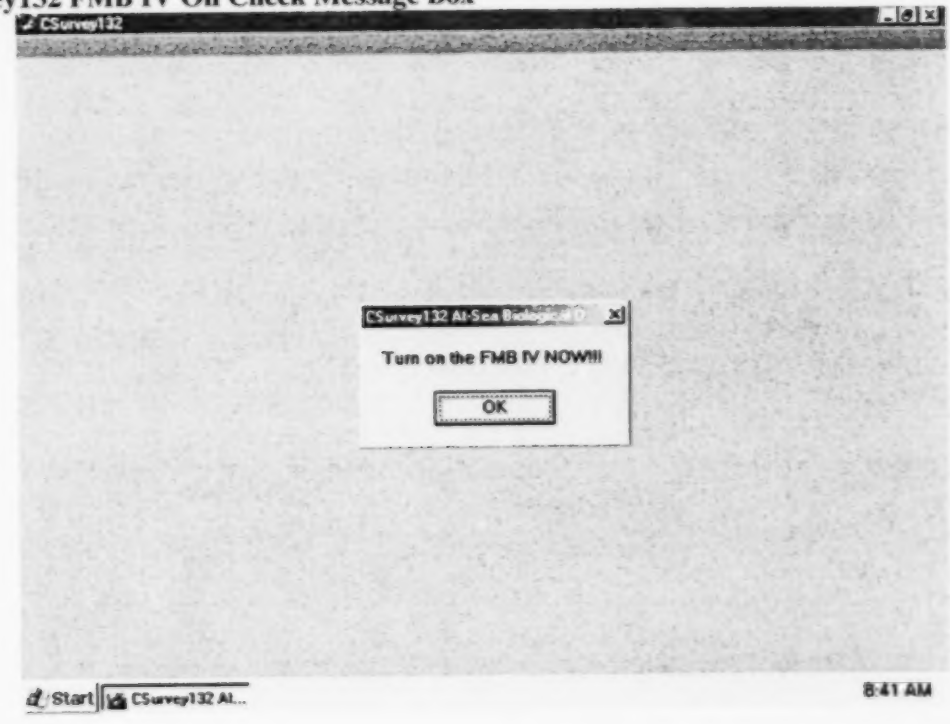
b) Csurvey132 Set and Species Information Window



c) Survey132 Sampling Options Window



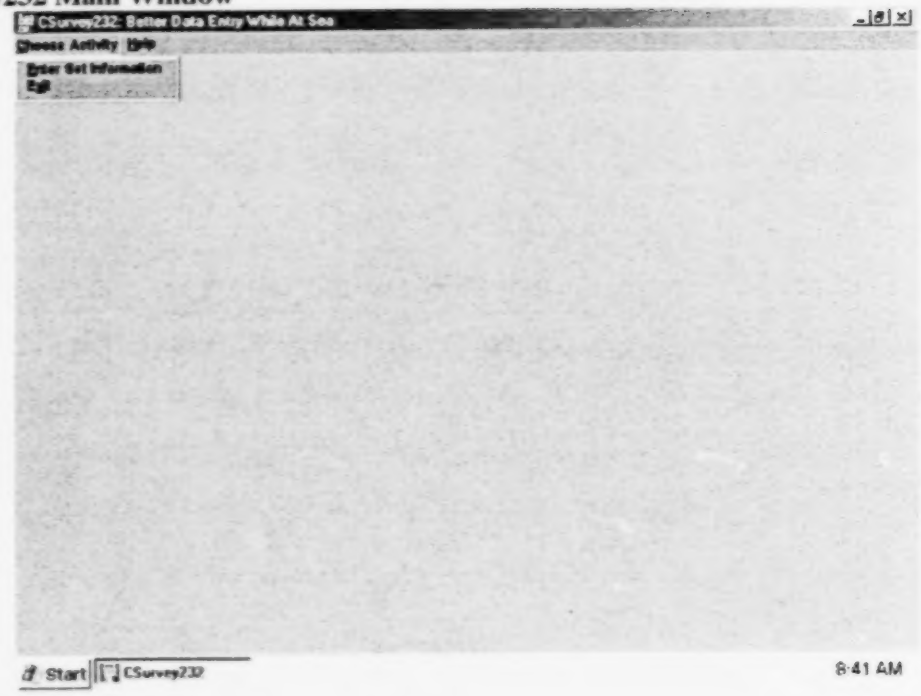
d) CSurvey132 FMB IV On Check Message Box



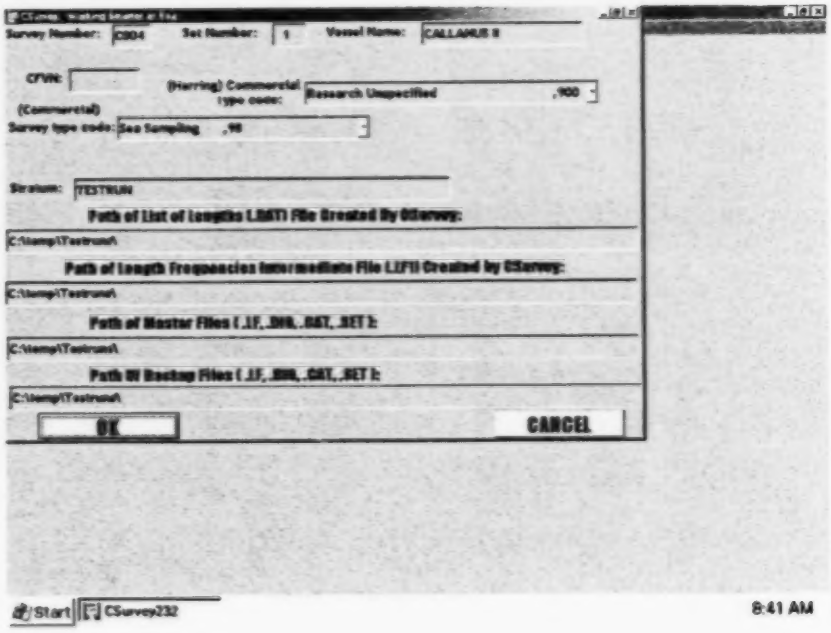
APPENDIX E

Images of CSurvey232 Windows

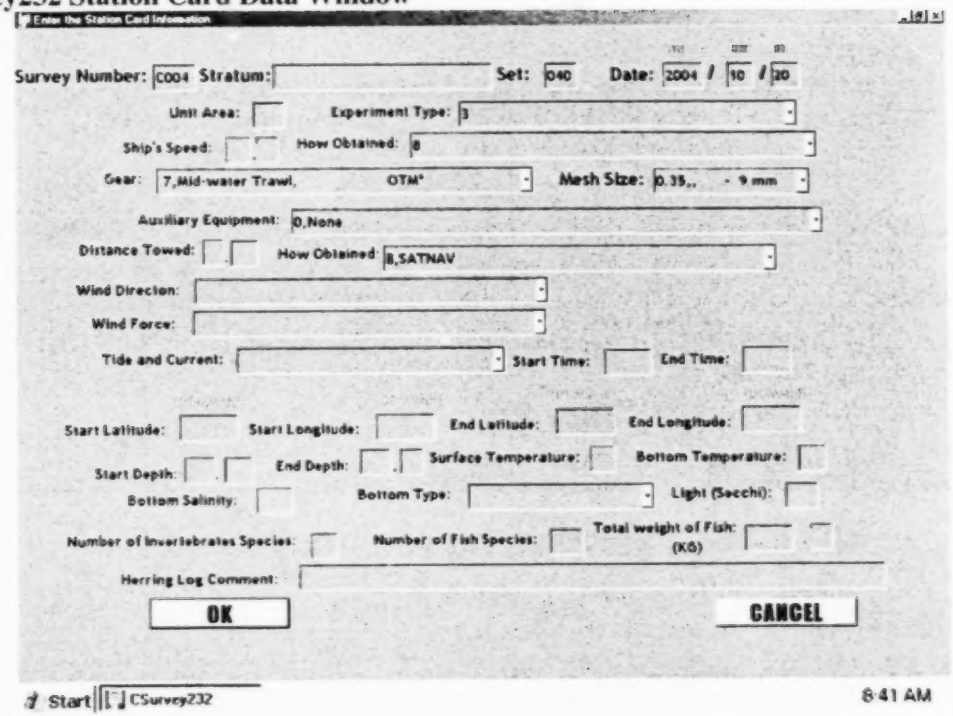
a) CSurvey232 Main Window



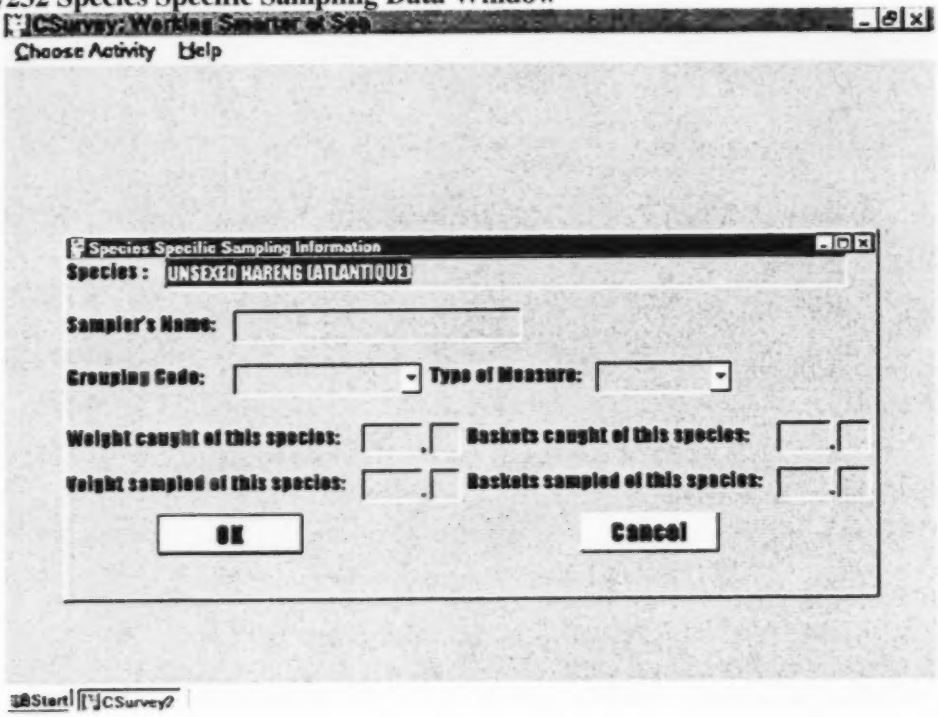
b) CSurvey232 Set and File Information Window



c) CSurvey232 Station Card Data Window



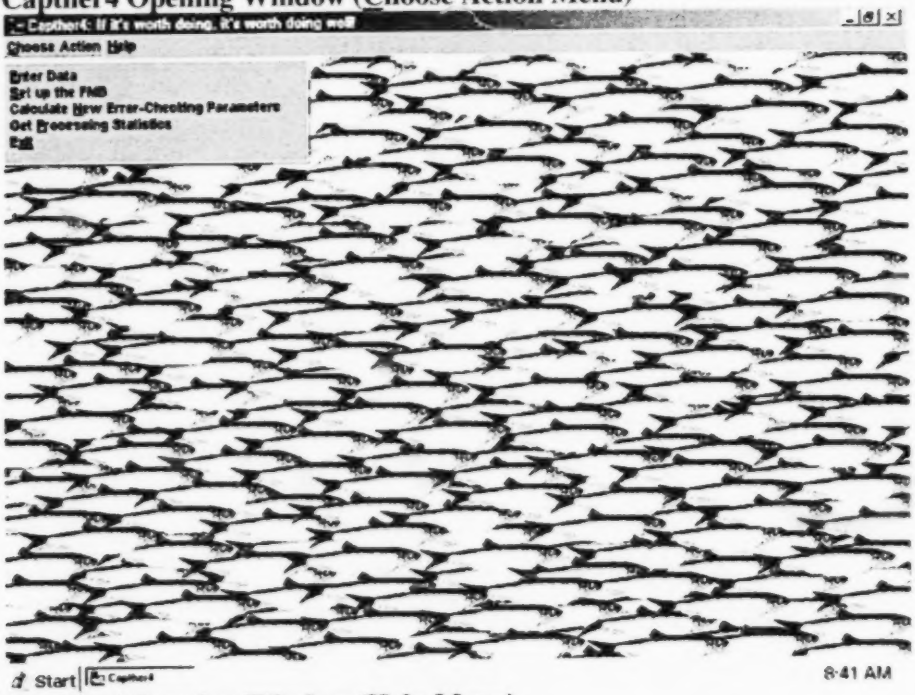
d) CSurvey232 Species Specific Sampling Data Window



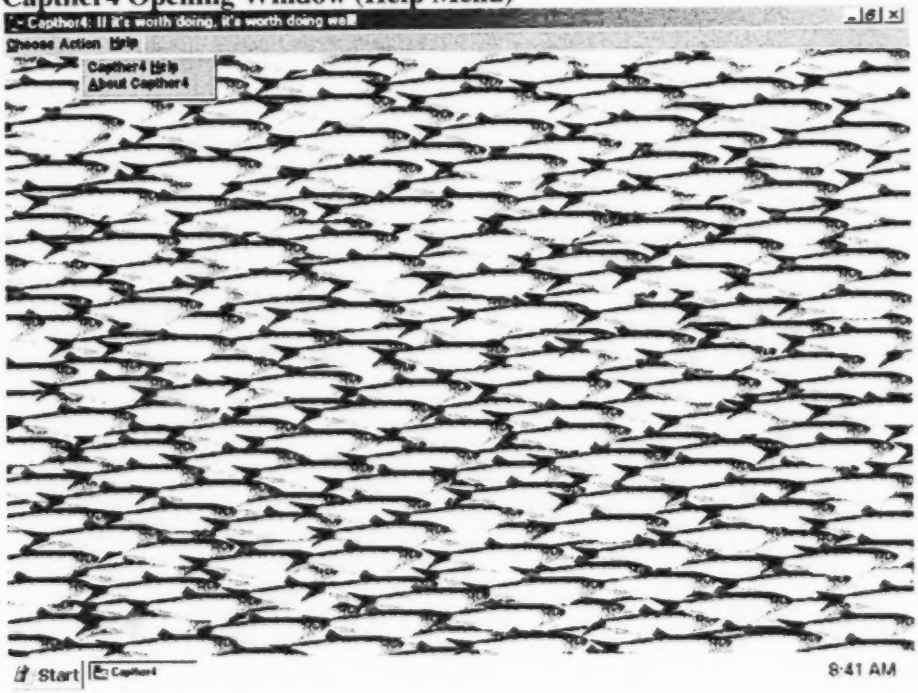
APPENDIX F

Images of Capther4 Windows

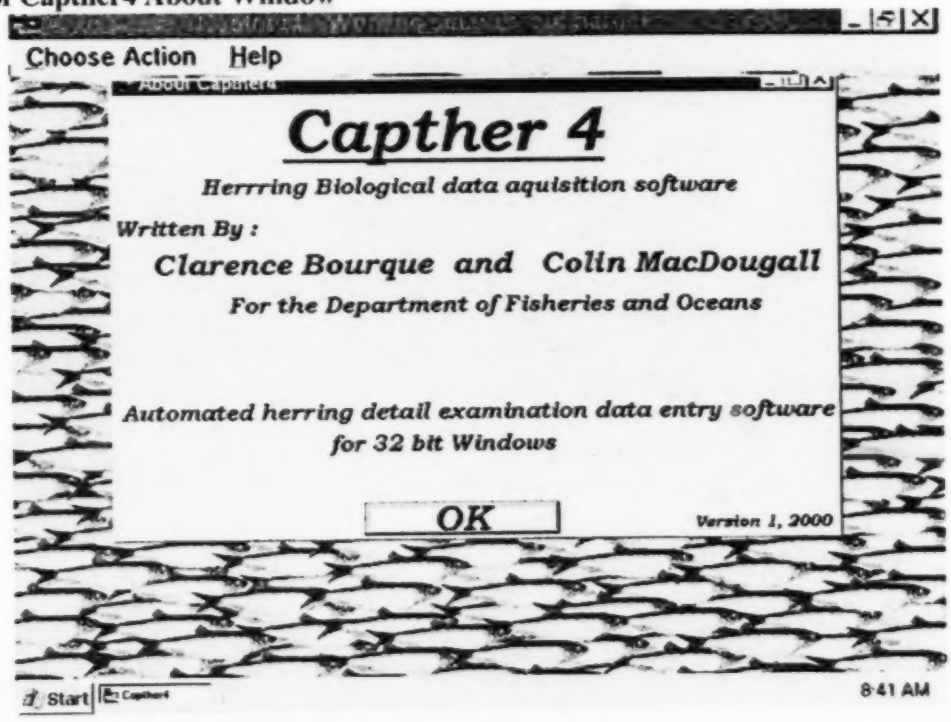
a) Image of Capther4 Opening Window (Choose Action Menu)



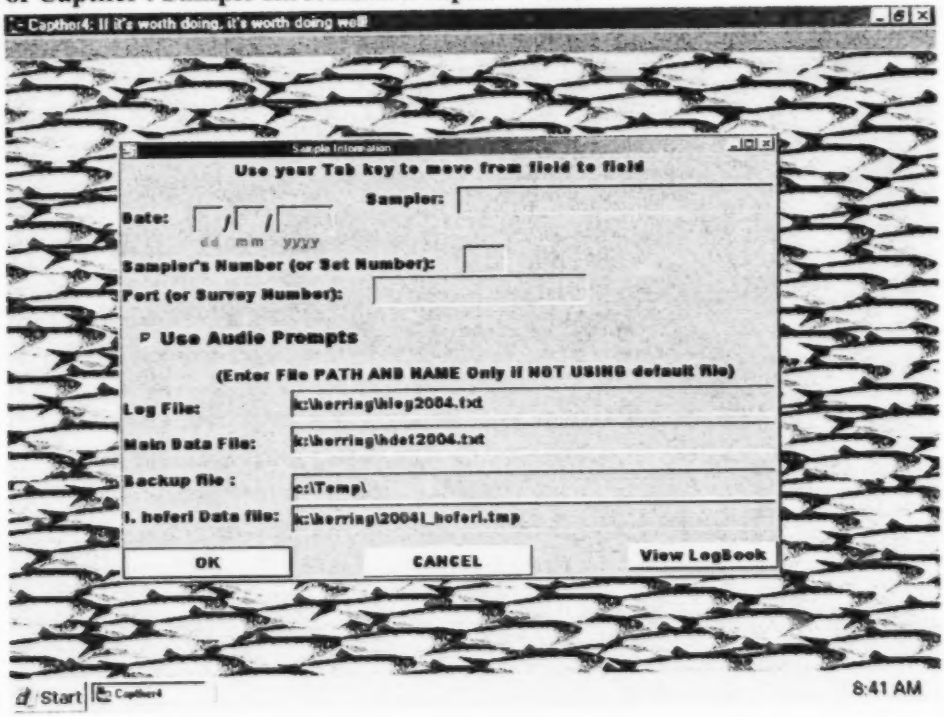
b) Image of Capther4 Opening Window (Help Menu)



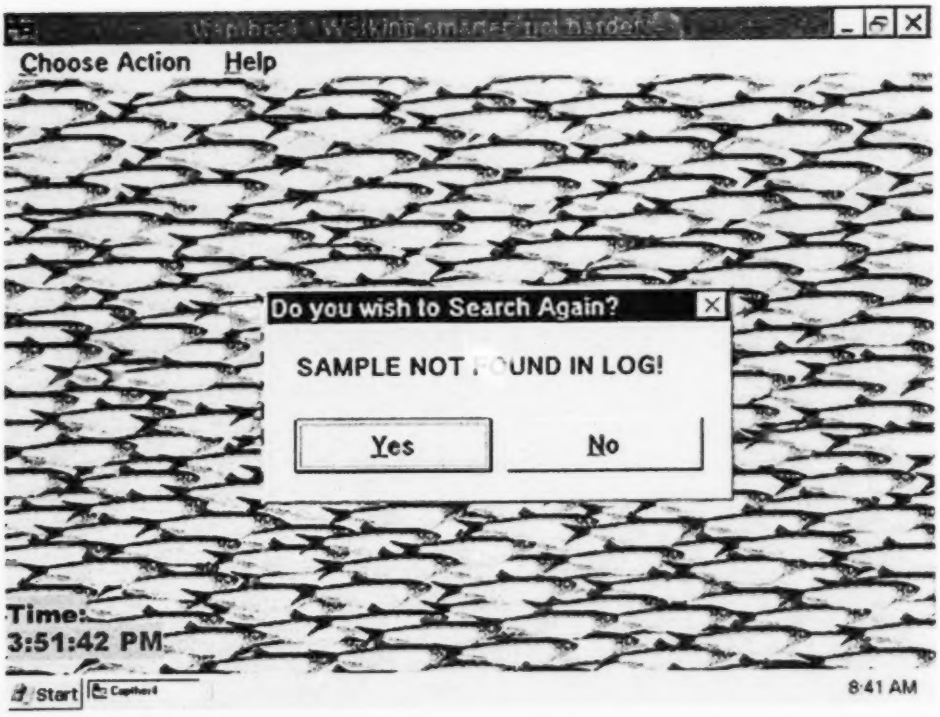
c) Image of Capther4 About Window



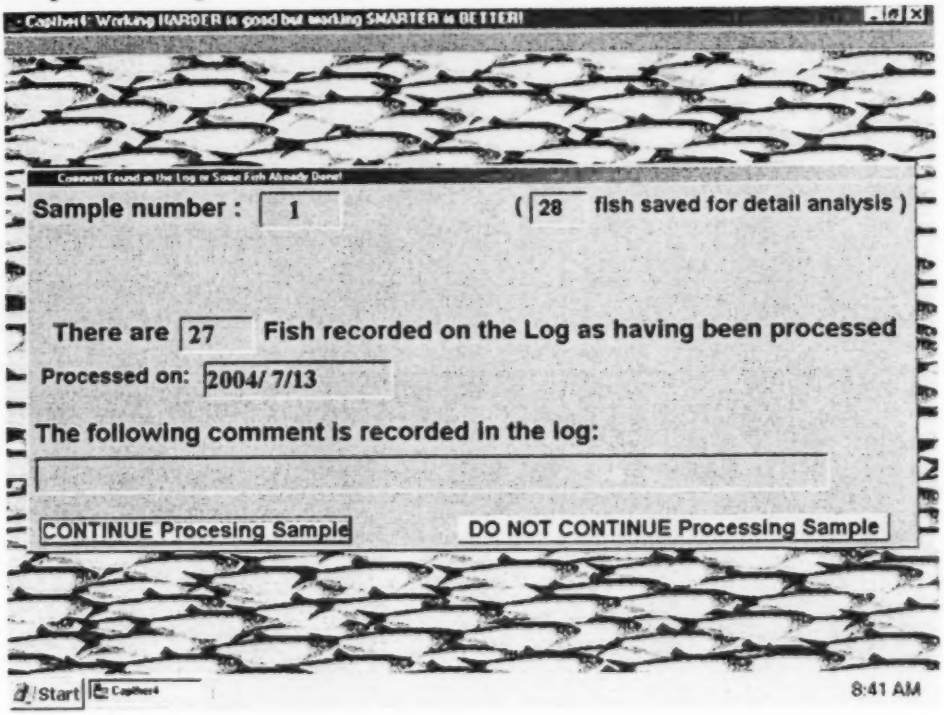
d) Image of Capther4 Sample Information Input Window



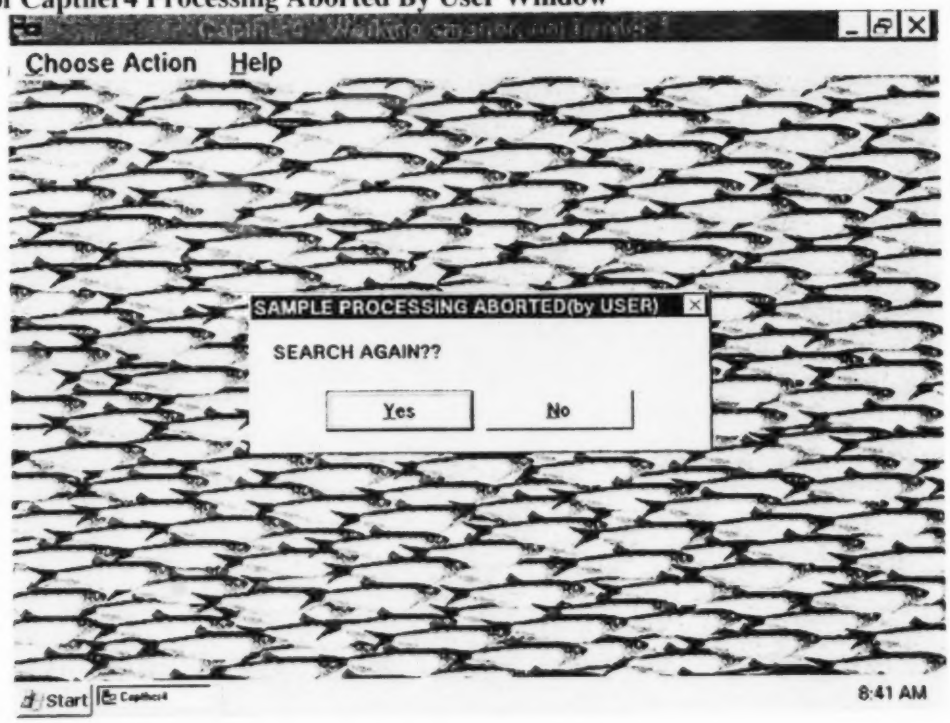
e) Image of Capther4 Sample Not Found Message Box Window



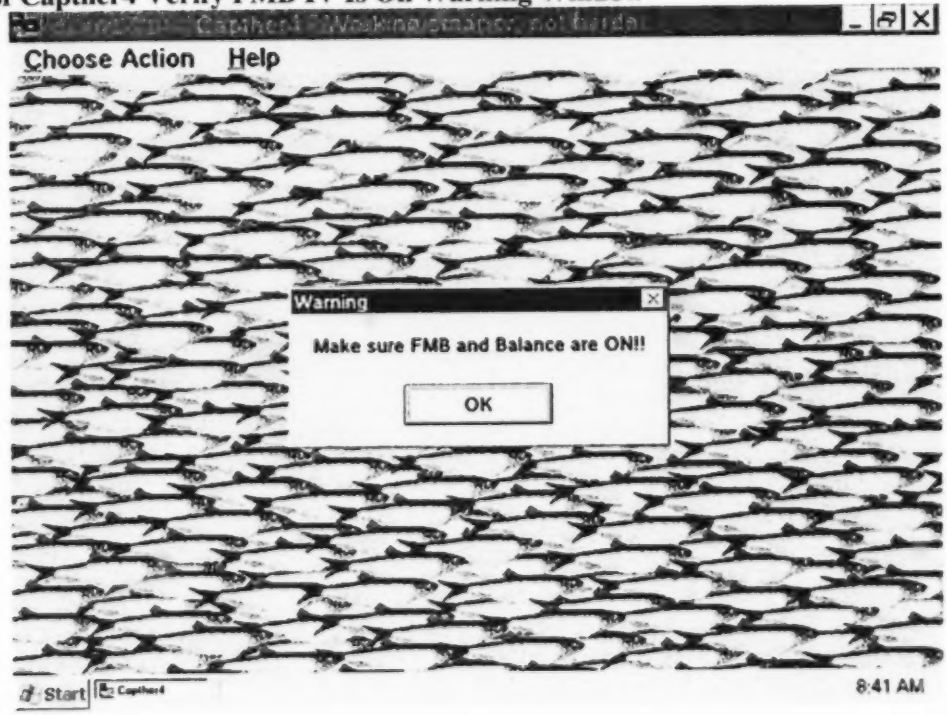
f) Image of Capther4 Sample Previously Processed or Comment Found Warning Window


Comment Found in the Log or Some Fish Already Done!
Sample number : 1
(28 fish saved for detail analysis)
There are 27 Fish recorded on the Log as having been processed
Processed on: 2004/ 7/13
The following comment is recorded in the log:
CONTINUE Procesing Sample
DO NOT CONTINUE Processing Sample
Start
8:41 AM

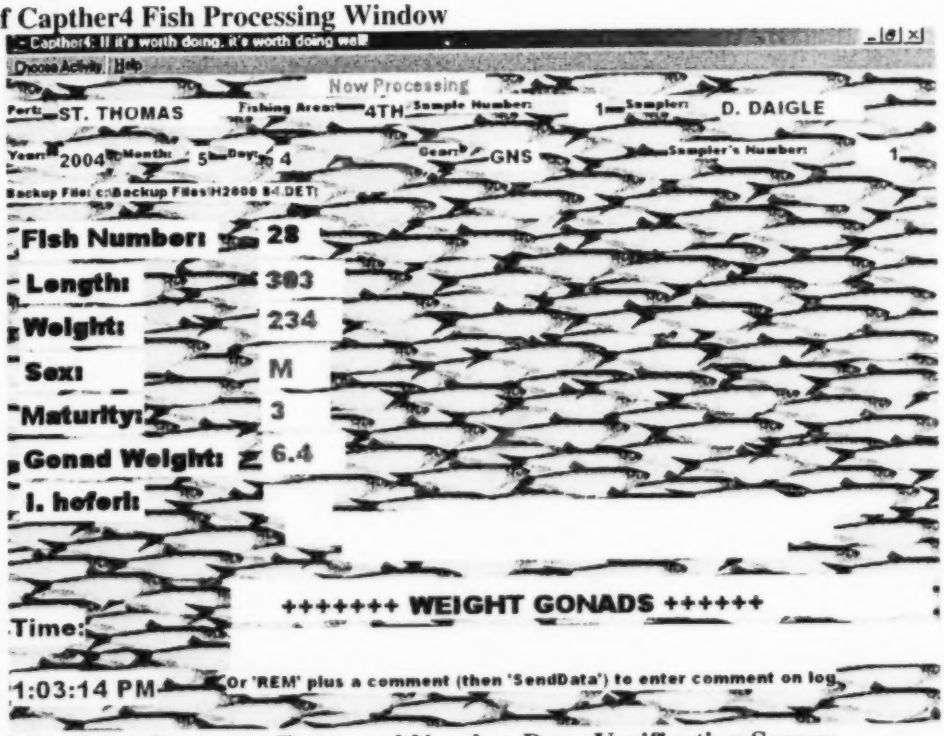
g) Image of Capther4 Processing Aborted By User Window



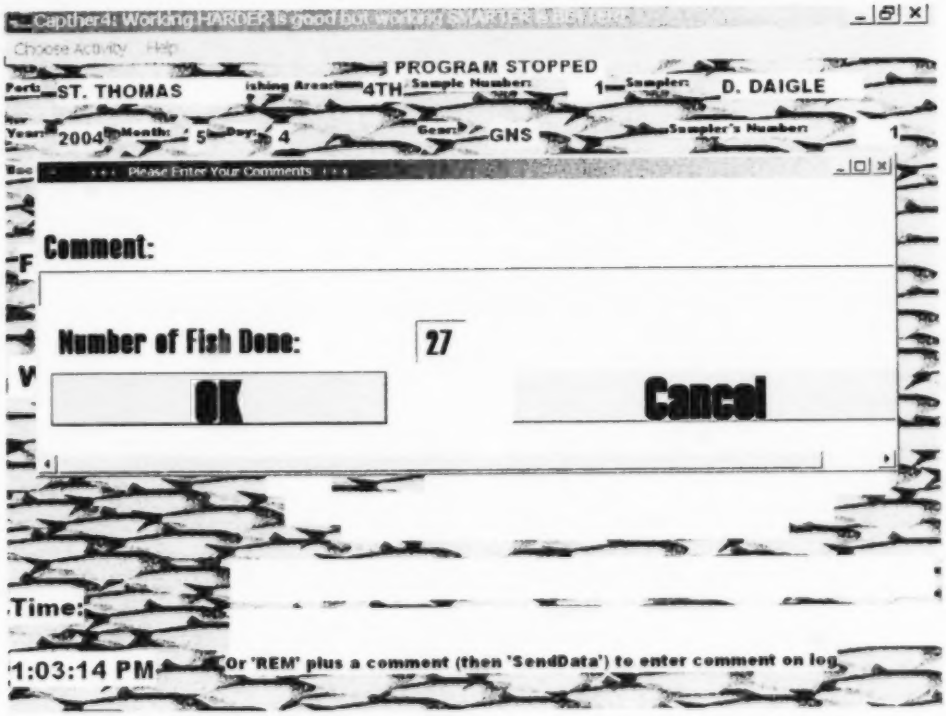
h) Image of Capther4 Verify FMB IV Is On Warning Window



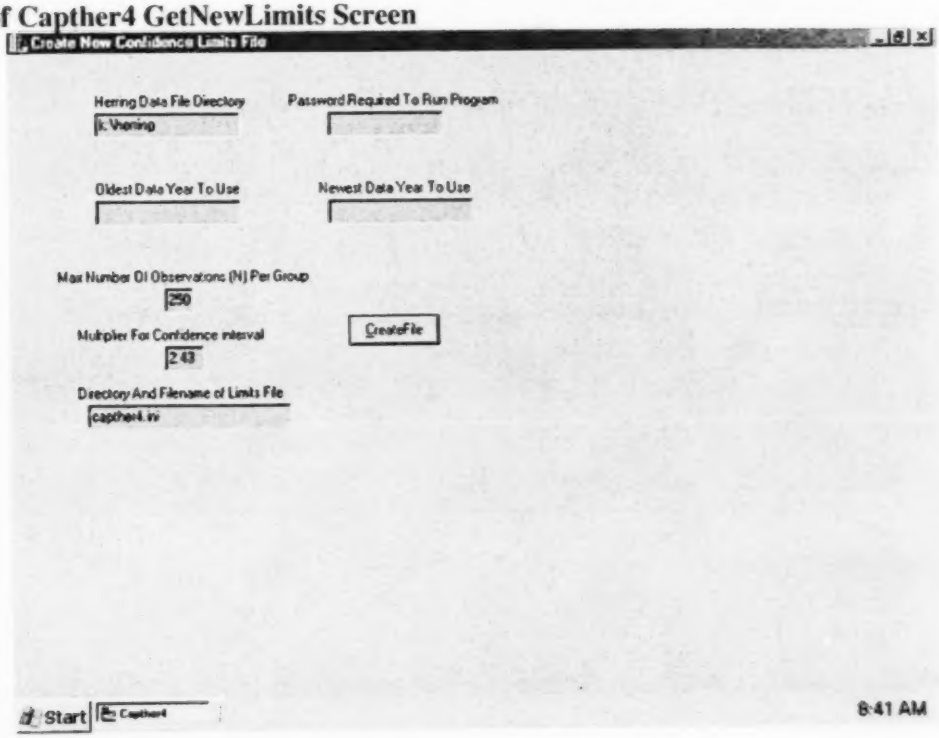
i) Image of Capther4 Fish Processing Window



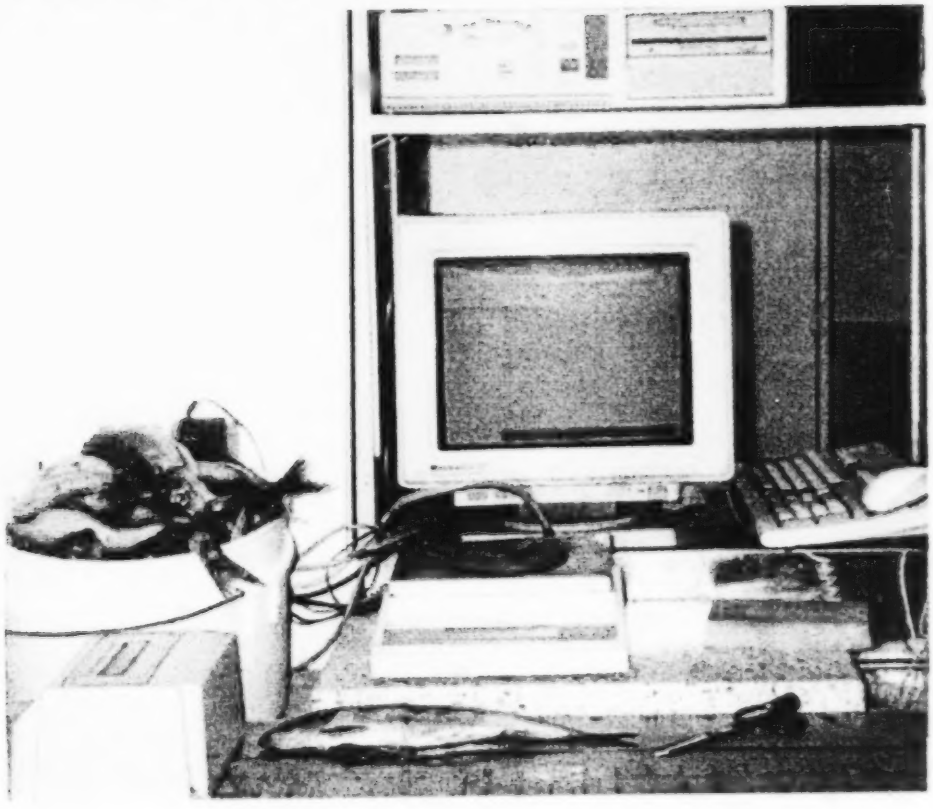
j) Image of Capther4 Comment Entry and Number Done Verification Screen



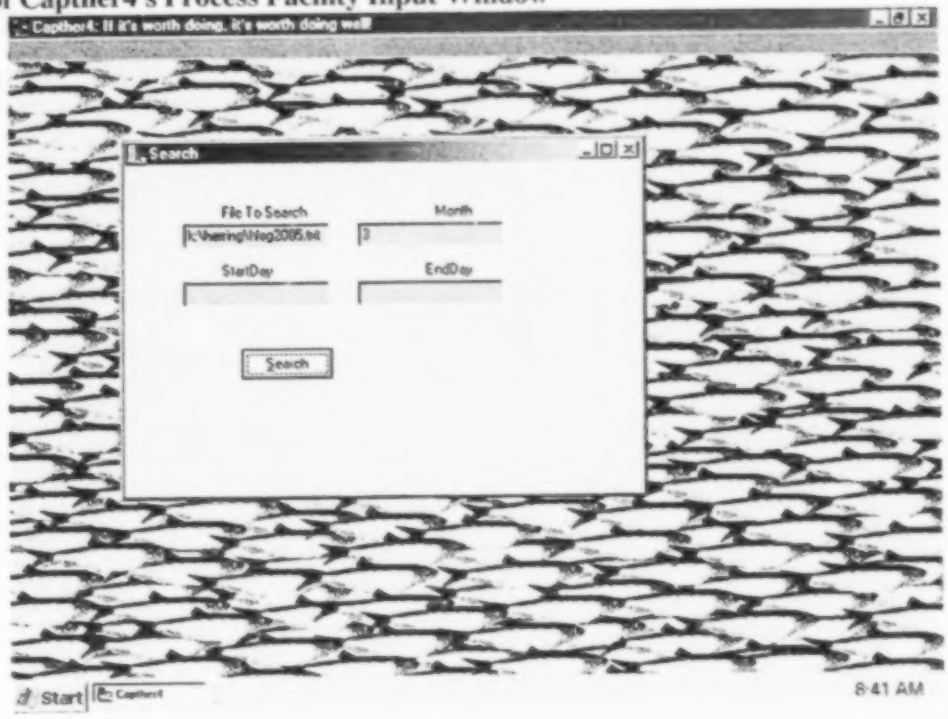
k) Image of Capther4 GetNewLimits Screen



l) Image of Capther4 System In Operation



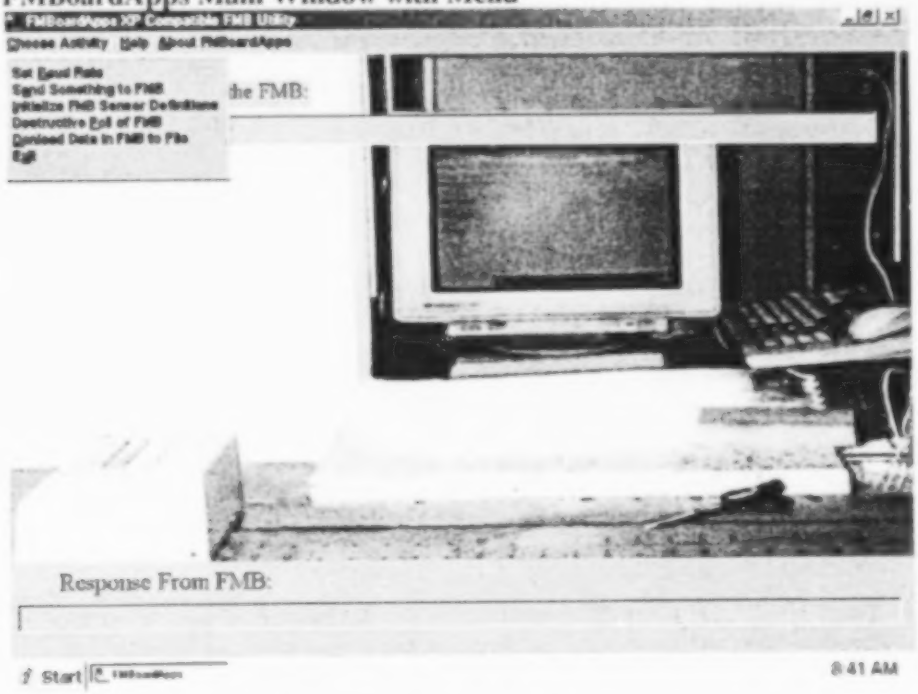
m)Image of Capther4's Process Facility Input Window



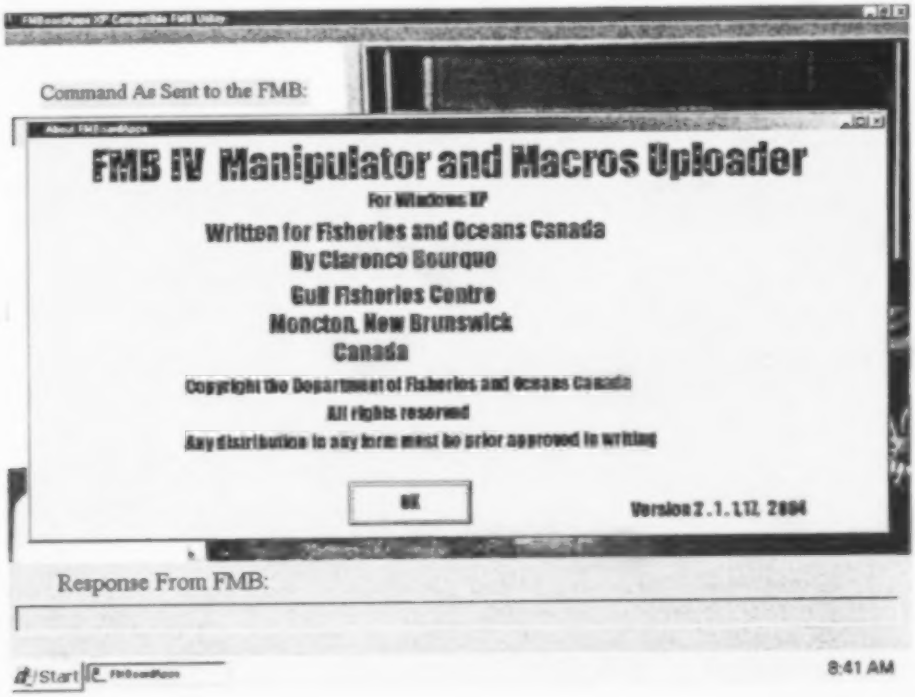
APPENDIX G

Images of FMBoardApps Windows

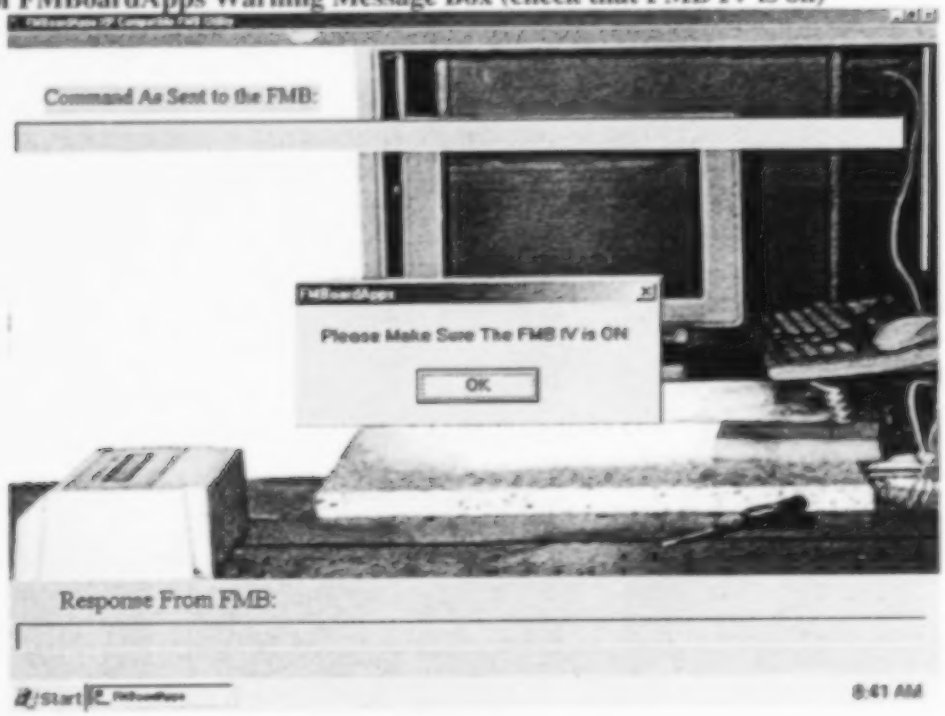
a) Image of FMBoardApps Main Window with Menu



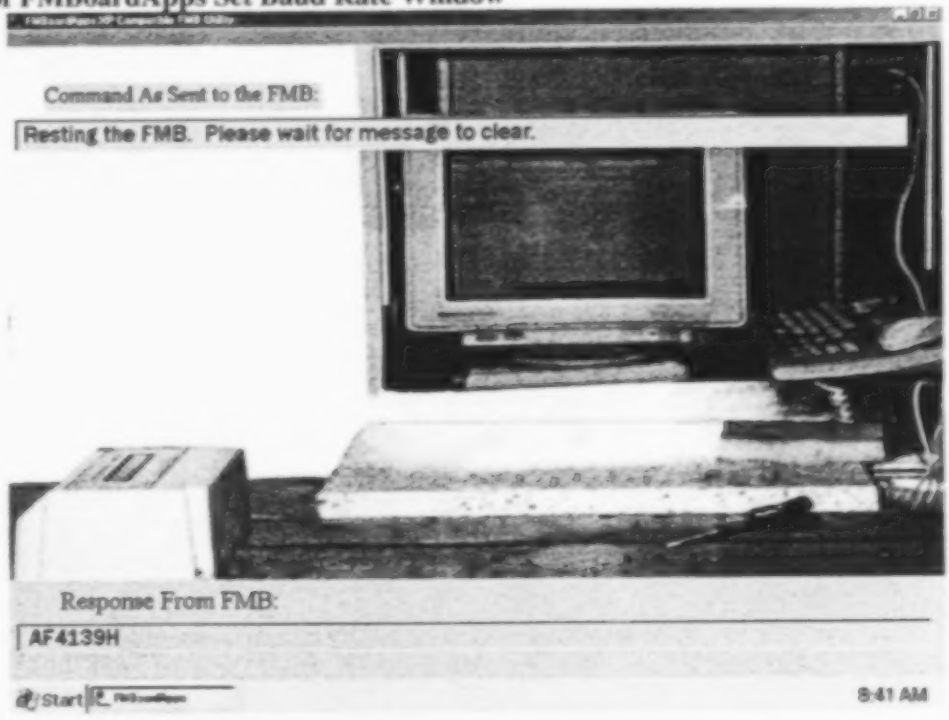
b) Image of FMBoardApps About Information Window



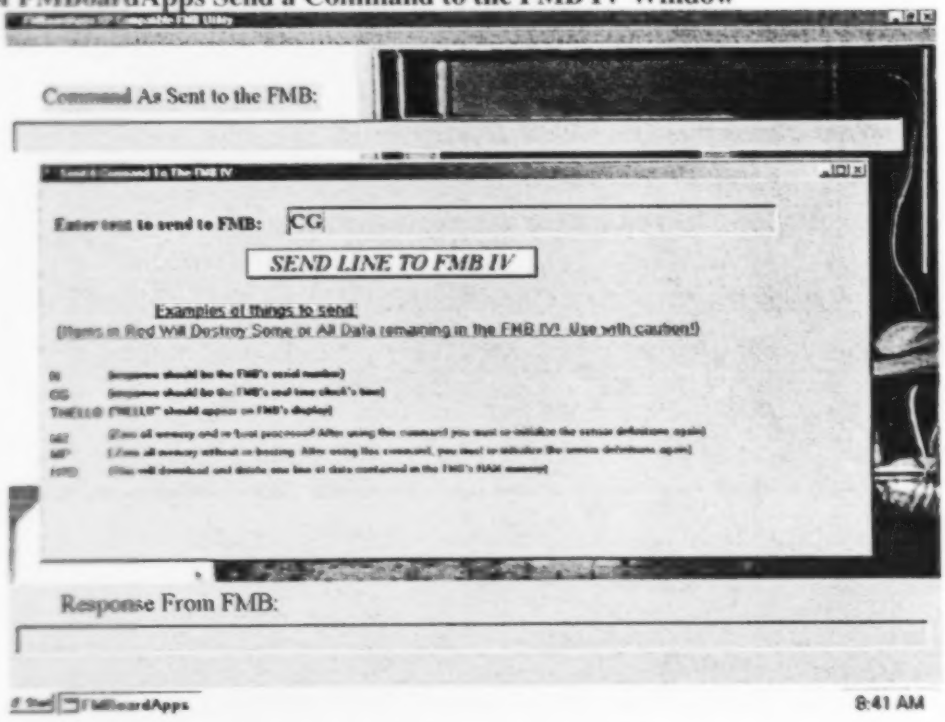
c) Image of FMBoardApps Warning Message Box (check that FMB IV is on)



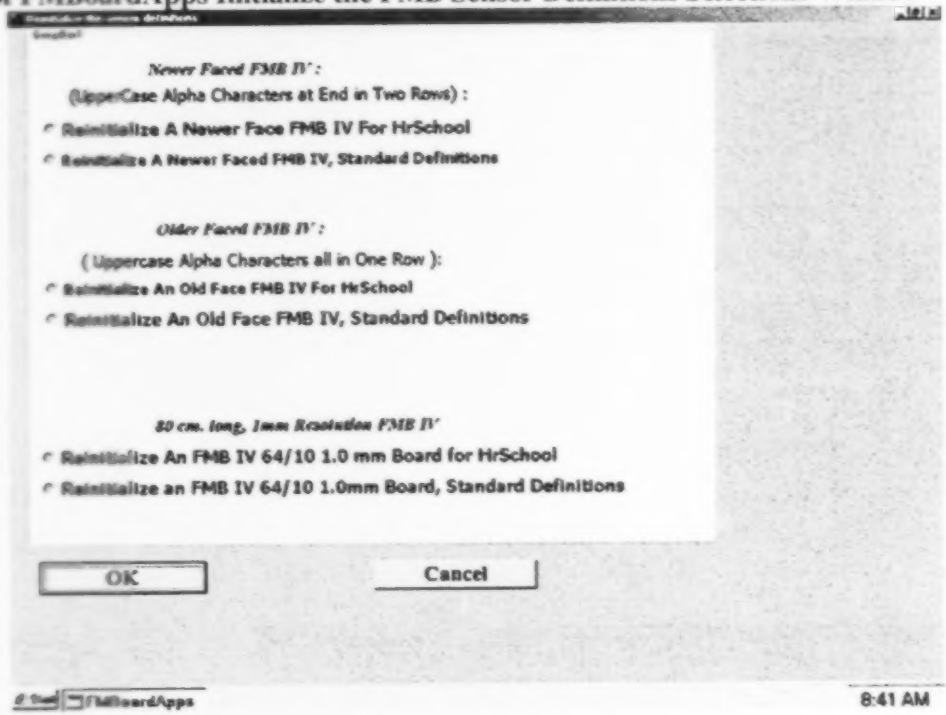
d) Image of FMBoardApps Set Baud Rate Window



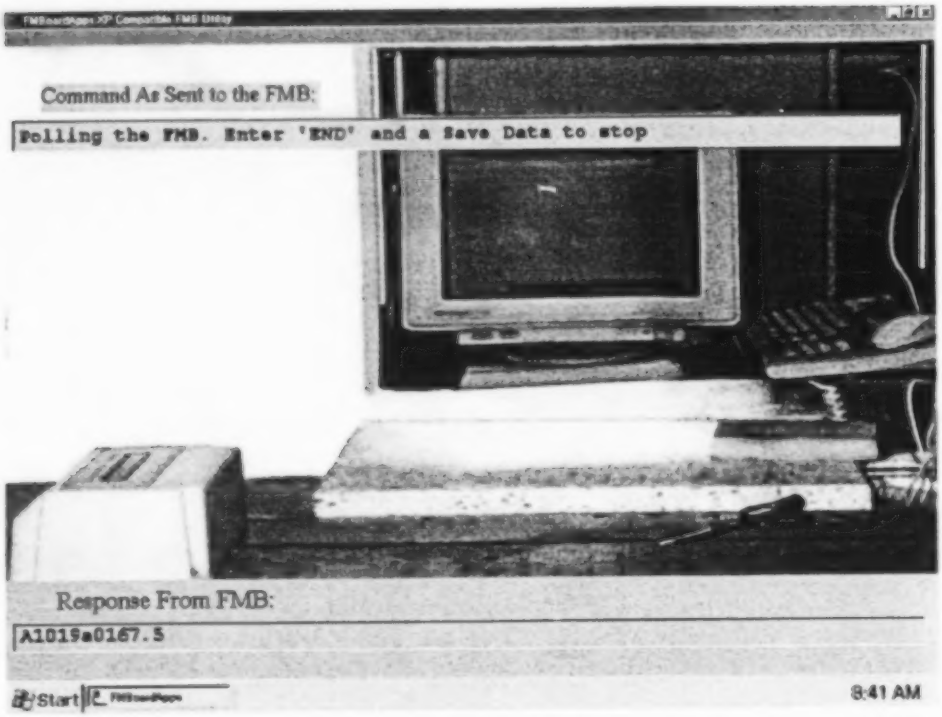
e) Image of FMBoardApps Send a Command to the FMB IV Window



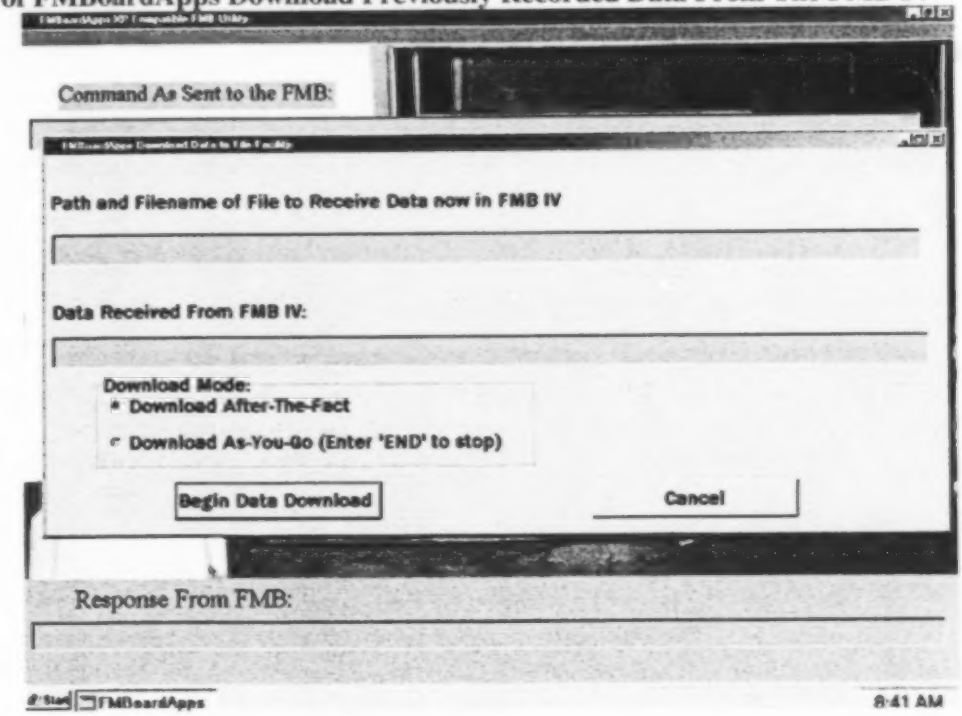
f) Image of FMBoardApps Initialize the FMB Sensor Definitions Selections Window


Newer Faced FMB IV :
(UpperCase Alpha Characters at End in Two Rows) :
Reinitialize A Newer Face FMB IV For HrSchool
Reinitialize A Newer Faced FMB IV, Standard Definitions
Older Faced FMB IV :
(Uppercase Alpha Characters all in One Row):
Reinitialize An Old Face FMB IV For HrSchool
Reinitialize An Old Face FMB IV, Standard Definitions
80 cm. long, 1mm Resolution FMB IV
Reinitialize An FMB IV 64/10 1.0 mm Board for HrSchool
Reinitialize an FMB IV 64/10 1.0mm Board, Standard Definitions
OK
Cancel
FMBoardApps
8:41 AM

g) image of FMBoardApps Destructive Poll of the FMB IV Window



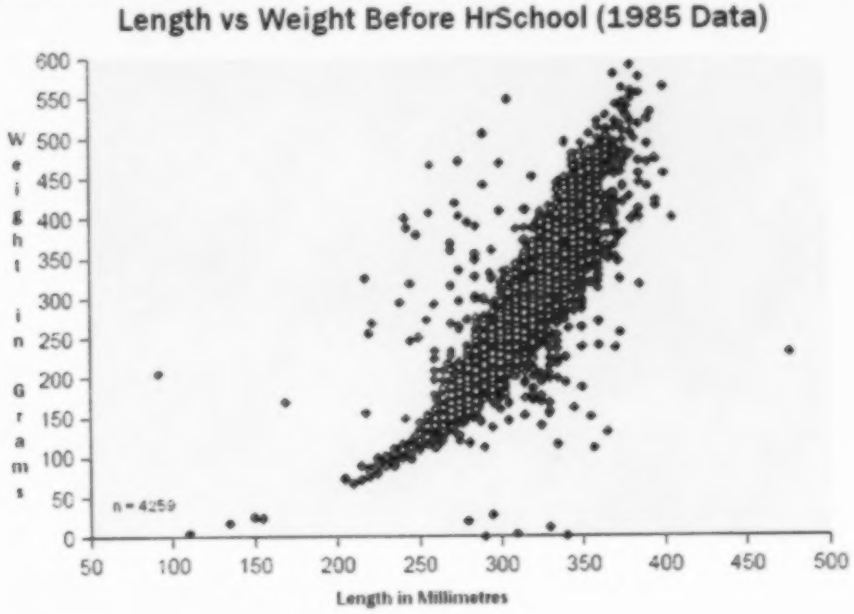
h) Image of FMBoardApps Download Previously Recorded Data From The FMB IV



APPENDIX H

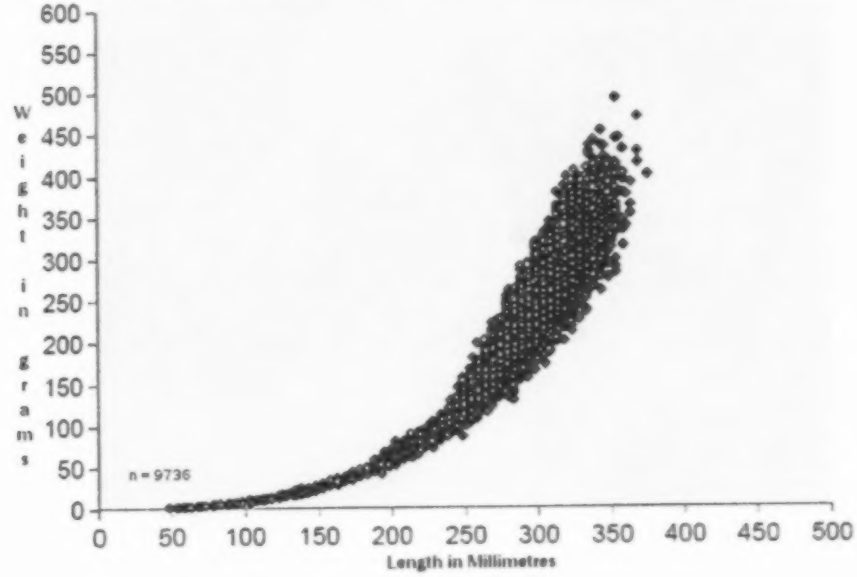
Representative Scatter Plots of Length vs. Weight

a) Scatter Plot of Length vs. Weight of Unedited Detail Data For The Year 1985



(Data Gathered using traditional methods)

b) Scatter Plot of Length vs. Weight of Unedited Detail Data For The Year 2004



(Data gathered using the HrSchool system)